# PRELIMINARY ENGINEERING REPORT

ON

# PROPOSED ALBERTA-MONTREAL CRUDE OIL PIPELINE

PREPARED FOR

## HOME OIL COMPANY LIMITED

BY

DUTTON-WILLIAMS BROTHERS LIMITED

ENGINEERS - CONSTRUCTORS

CALGARY, ALBERTA

VOLUME I

Energy
Exhibit no. CC-29-1
vol. 1
1958

# PRELIMINARY ENGINEERING REPORT

ON

# PROPOSED ALBERTA - MONTREAL CRUDE OIL PIPELINE

Prepared for

HOME OIL COMPANY LIMITED

12

by

DUTTON-WILLIAMS BROTHERS LIMITED
Engineers - Constructors
Calgary, Alberta

February 26, 1958

VOLUME I

DUTTON - WILLIAMS BROTHERS LIMITED

ENGINEERS — CONSTRUCTORS

NORTH CANADIAN OIL BUILDING

CALGARY, ALBERTA

REPLY TO Project 3094

February 26, 1958.

Home Oil Company Limited
304 Sixth Avenue West
Calgary, Alberta

Gentlemen:

In accordance with your instructions of January 15, 1958, we have prepared the attached Preliminary Engineering Report on the proposed Alberta-Montreal Pipeline crude oil system. We believe the report sufficiently examines the factors involved and adequately defines a system for planning purposes.

Conclusions

1. Under the conditions considered, the 30-inch "Southern Route" system appears to offer the most economical transportation and also the best balance between investment and operating cost.

   In evaluating the alternatives, no limitation was placed upon possible sizes of the main pipeline or possible routes to be compared. A comparison of the recommended system with an alternate route and size is, however, made in the report to illustrate the basis for this conclusion. The comparative capital requirements for the 30-inch alternates are set forth as follows for the initial and tenth year of operation:

| Classification | Southern Route 1960 | Southern Route 1969 | Northern Route 1960 | Northern Route 1969 |
|---|---|---|---|---|
| Construction Costs | $307,500,000 | $332,100,000 | $350,900,000 | $379,100,000 |
| Line Fill | 24,100,000 | 24,100,000 | 25,500,000 | 25,500,000 |
| Int. during Const. | 12,100,000 | 12,600,000 | 13,800,000 | 14,400,000 |
| Working Capital | 1,900,000 | 1,900,000 | 2,000,000 | 2,000,000 |
| Financing Costs | 7,800,000 | 7,800,000 | 8,700,000 | 8,700,000 |
| | $353,400,000 | $378,500,000 | $400,900,000 | $429,700,000 |

2. Based upon the capital requirements for the recommended system, the 30-inch Southern Route System, the "cost of service" during the 5th year of operation per barrel transported as projected in the report is 51.8¢. "Cost of service" in this case includes depreciation, interest, operating cost, return on investment and income taxes. We believe a normal tariff schedule for crude oil pipelines employing this amount as the primary transportation charge from Alberta to Montreal could be recommended and that earnings generated at this rate on the assumed average throughput will be sufficient to effect financing of the project.

Report Summary

1. The initial capital requirements for the recommended system amounts to approximately $353,400,000 of which $307,500,000 is attributable to cost of the installation.

2. The initial system consists of approximately

    1,919 miles of 30-inch Main Line
    100 miles of 26-inch gathering line
    71.5 miles of 16-inch gathering line
    73.5 miles of 10-inch gathering line

    1,700,000 barrels of steel tank storage
    35,000 installed horsepower in pumping facilities

3. The initial capacity of the system is 253,000 BPD and by addition of pumping facilities may be economically increased to 393,000 BPD.

4. Average annual throughputs have been assumed to increase from 200,000 BPD in the first year of operation to 385,600 BPD in the 10th year, the final year considered.

Preparation of the Report

Route reconnaissance was made by automobile and aircraft over the various possibilities, and as a result two principal routes were selected for final consideration. A further check of critical points and alternate sections on these routes was made as needed. Detailed notes of a number of previous investigations over the entire area were also of assistance, as were actual construction cost information on the several existing pipeline systems which parallel all or parts of the routes considered.

Pipeline route locations were made with the use of aerial photographs and topographic maps and based upon the reconnaissance notes.

Hydraulic studies of the various routes were made after profiles were developed from the above information. Schematic arrangements of a number of alternative designs and routes were then produced. On the basis of preliminary cost estimates, a number of the alternatives were then eliminated. More exact cost estimates were then compiled for remaining alternates using quotations from manufacturers and other realistic data.

Operating costs then were prepared which further reduced the alternative schemes then deserving further comparison.

Financial requirements have been developed for the alternate systems to determine required income over the period of years from which tariff rates were selected. The rates were then used to project pro forma financial data for the future years of operation to test their adequacy.

Volume I is generally arranged to begin with the premises, followed by a design discussion, and concluded with the financial data derived therefrom. Volume II defines the system recommended in specification form suitable for incorporation with later detailed drawings and final bills of materials into complete plans and specifications of the system.

It is hoped that the report contains design decisions and sufficient definition of the system to facilitate the planning of this project.

Respectfully submitted,

DUTTON-WILLIAMS BROTHERS

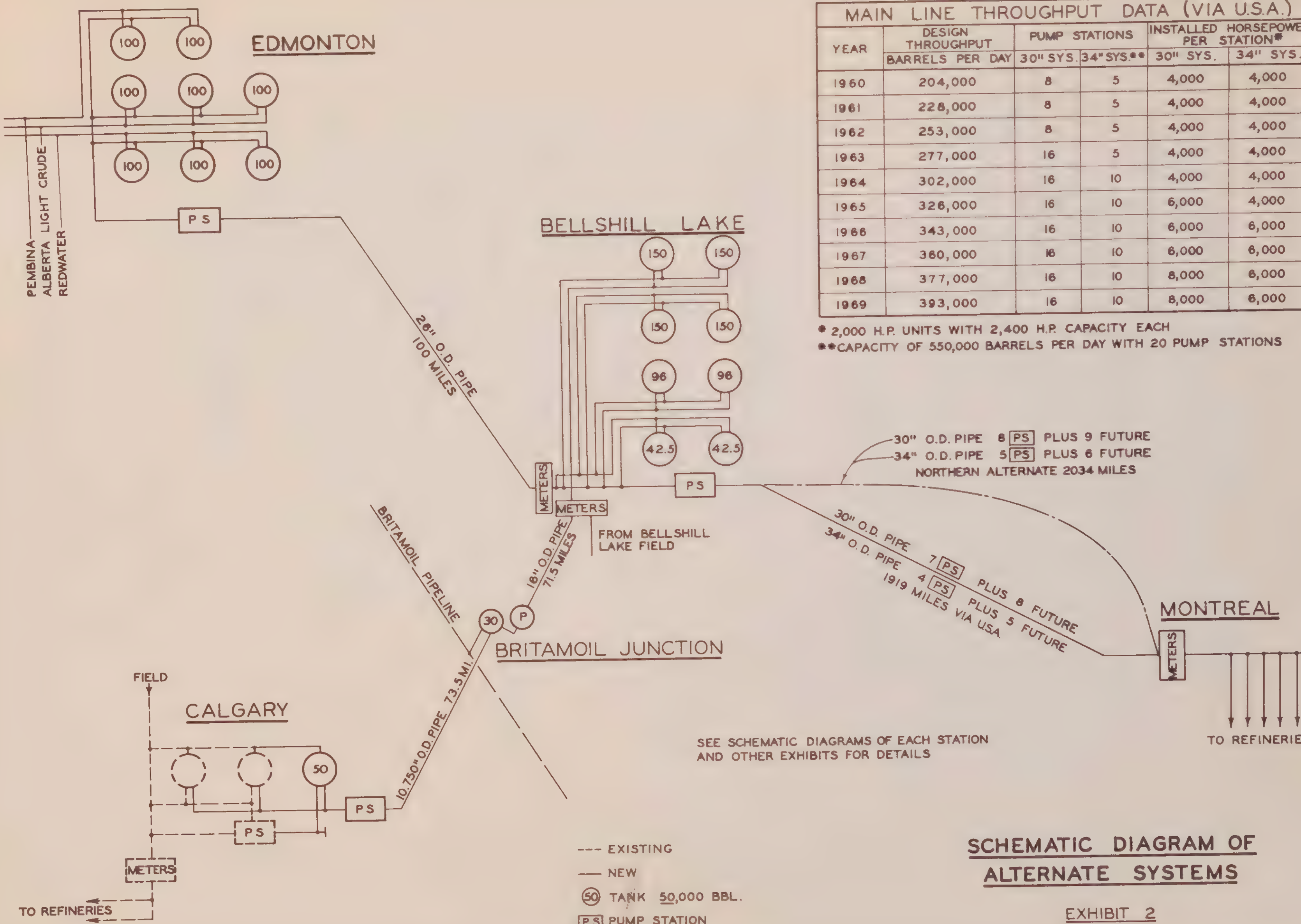
R. G. Murray, Jr.

R. G. Murray, Jr.
Executive Vice-President

SASKATCHEWAN
MANITOBA
EDMONTON
BELLSHILL LAKE STATION
CALGARY STATION
REGINA
WINNIPEG
DULUTH
MINNESOTA
TORONTO
ALTERNATE ROUTE
30" — 18 Stations
34" — 12 Stations
ROUTE MAP
LEGEND
PIPELINE
5 — STATION NO — 30" PIPELINE
5 — STATION NO — 34" PIPELINE
EXHIBIT 1

| MAIN LINE THROUGHPUT DATA (VIA U.S.A.) | | | | | |
|---|---|---|---|---|---|
| YEAR | DESIGN THROUGHPUT | PUMP STATIONS | | INSTALLED HORSEPOWER PER STATION* | |
| | BARRELS PER DAY | 30" SYS. | 34" SYS.** | 30" SYS. | 34" SYS. |
| 1960 | 204,000 | 8 | 5 | 4,000 | 4,000 |
| 1961 | 228,000 | 8 | 5 | 4,000 | 4,000 |
| 1962 | 253,000 | 8 | 5 | 4,000 | 4,000 |
| 1963 | 277,000 | 16 | 5 | 4,000 | 4,000 |
| 1964 | 302,000 | 16 | 10 | 4,000 | 4,000 |
| 1965 | 326,000 | 16 | 10 | 6,000 | 4,000 |
| 1966 | 343,000 | 16 | 10 | 6,000 | 6,000 |
| 1967 | 360,000 | 16 | 10 | 6,000 | 6,000 |
| 1968 | 377,000 | 16 | 10 | 8,000 | 6,000 |
| 1969 | 393,000 | 16 | 10 | 8,000 | 6,000 |

* 2,000 H.P. UNITS WITH 2,400 H.P. CAPACITY EACH
** CAPACITY OF 550,000 BARRELS PER DAY WITH 20 PUMP STATIONS




## SCHEMATIC DIAGRAM OF ALTERNATE SYSTEMS

EXHIBIT 2

TNC

VOLUME I

# ENGINEERING AND ECONOMIC STUDIES

## Table of Contents

Table of Contents (Continued)

## DESIGN EXHIBITS

# CHAPTER I

# ENGINEERING STUDIES

## A. INTRODUCTION

### 1. FUNCTION OF THE SYSTEM

The purpose of the proposed Alberta-Montreal crude oil pipeline is to provide the most economical transportation for the proven and potential oil reserves in Western Canada to the Montreal refining area. Although evaluations of the crude supply, market outlets and determinations of probable minimum shipments over a ten year period have been prepared by others, the function of the system can be briefly described as follows.

Present outlets for Alberta crude consume less than 50 percent of the rated production capacity. Reserves due to new discoveries are increasing at a rate greater than the potential consumption of present markets. Exploration and drilling operations are slowing due to lack of payout for new discoveries.

Meanwhile, the Montreal area imports a substantial amount of foreign crude at a cost representing about one-third of Canada's trade deficit. A foreign source of such crude is subject to variations in world affairs and upon ocean transportation. This factor may be critical in case of a world or Canadian national emergency.

Present crude oil transportation from Alberta eastward, which might be extended to Montreal, is operating at such capacity that it could not serve the Montreal market in any quantity without a corresponding reduction in its present service to other points.

Montreal is the only marketing area remaining in Canada with sufficient demand to substantially utilize shut-in reserves in Alberta. Export of these reserves to the United States is continuously dependent upon the prevailing import policy of the United States to protect its own producers, and continuously dependent upon prevailing competitive prices of other foreign crudes which may be imported without field proration at the source.

The function of the proposed pipeline system, then, would be to provide a transportation medium of such economic effectiveness that the eastern Canadian market of the Montreal area may be served competitively by Canadian reserves.

## 2. PURPOSE AND SCOPE OF THE REPORT

This report has been prepared under the instructions of Home Oil Company Limited, representing a group of Alberta producers. The report summarizes results of route reconnaissance and planning studies undertaken to determine an economical crude oil transmission system from Alberta to Montreal.

The purpose of the report is fivefold:

(1) To define alternate systems derived from field engineering and economic studies as appearing most feasible for present and future indicated needs.

(2) To recommend one of the alternate systems as most satisfactory based on the premises supplied.

(3) To supply realistic cost estimates for financial arrangements.

(4) To furnish an estimate of required annual income and tariff rates necessary to support the system.

(5) To present sufficiently definitive engineering and economic aspects to permit construction to proceed with a minimum of delay.

Certain aspects of the feasibility of the system are beyond the scope of this report, and beyond the assignment therefor. These aspects include:

(1) A discussion of the reserves in Alberta or more particularly the adequacy or selection of certain fields or areas in Alberta to satisfy pipeline throughput premises, or the designation of gathering points.

(2) Evaluation of the Montreal area as an outlet for Western crude oil.

(3) Evaluation of the effect of the tariffs derived in this report upon competitive marketing, or upon the economics of production.

It is understood however that the foregoing aspects have been or will concurrently be treated in reports by others.

## 3. TERMINOLOGY

Some brief reference terms have been utilized to avoid repeating descriptive identifications throughout the report.

Definitions of such terms follow:

| | |
|---|---|
| Company | the owner of the proposed Alberta-Montreal crude oil pipeline system |
| Calgary Lateral | the lateral from Calgary to Bellshill Lake, crossing the Britamoil pipeline between the Stettler and Drumheller fields |
| Britamoil Junction | the junction point between the Britamoil pipeline and Calgary Lateral |
| Edmonton Lateral | the lateral from Edmonton to Bellshill Lake |
| Main Line, mainline | the pipeline from Bellshill Lake to Montreal |
| bbl. | barrel |
| BPD | barrels per day |
| MBPD | thousands of barrels per day |
| MBPYr | thousands of barrels per year |
| psi | pounds per square inch |
| OD | outside diameter |
| ID | inside diameter |
| dia. | diameter |
| wall | wall thickness of pipe |
| SSU | Saybolt Seconds Universal |
| API | American Petroleum Institute |
| ASA | American Standards Association |
| $^{o}F$ | degrees Fahrenheit |

| | |
|---|---|
| MP | milepost measured from origin of traverse |
| " | inches |
| ' | feet |
| HP | hydraulic horsepower |
| HPo, BHP | operating horsepower or brake horse-power |
| HPi | installed horsepower |
| matl | material |
| const | construction |

## B. PREMISES OF PIPELINE SYSTEM

### 1. DISCUSSION OF DEMAND

As previously stated, it is beyond the scope and assignment of this study to develop the demand or supply aspects of crude oil for this system. However, throughput requirements in general were derived as outlined herein.

From the recent study by Walter J. Levy, oil economics consultant, the demand for foreign crude oil and products in the Montreal area for 1960 is estimated to be 282,000 BPD and 32,000 BPD respectively. (See Page 1-12, Levy report.) It has also been estimated that the Alberta-Montreal pipeline could supply replacement of 70 percent of this crude oil market, or 200,000 BPD.

Present Montreal refiners operate on crude stock averaging 30° API gravity (at 60°F), composed principally of Venezuelan and Middle East crudes ranging from 25° API to possibly 35° API. Alberta crudes tentatively selected to serve Montreal have an average gravity of about 35.5° API.

Complete utilization of a lighter charge stock would effect a further deficit in heavy fuel oil supply in the area. This deficit should eventually be mitigated or possibly eliminated by natural gas utilization from the Trans-Canada pipeline. Also, if the trend to higher motor octanes continues, future refinery additions and new installations may require the higher gravity stock afforded by Alberta.

Some of these and other considerations are treated in detail in the Levy and Purvin & Gertz reports. However, the considerations briefly mentioned above substantiate the fact that about 70 percent of the 1960 Montreal demand for crude oil could reasonably be satisfied by Alberta crudes, and a higher percentage thereafter.

The Levy report (Page 1-16) further states that in 1965 crude oil demand in the Montreal area would reach some 396,000 BPD with no products imports required. It is assumed the Alberta-Montreal pipeline could capture 80 percent of this market, or 320,000 BPD, in light of the foregoing discussion and more detailed analysis. The throughput buildup in the pipeline between 200,000 BPD in 1960 and 320,000 BPD in 1965 is assumed as a straight line to obtain annual increments.

After 1965, it is assumed that Canadian crude oil can supply 100 percent of the increase in Montreal requirements at the 1960 to 1965 rate of demand growth. In 1960, a total of 314,000 BPD of crude oil and products demand is projected as previously stated. The 1965 demand is similarly 396,000 BPD -- an increase of 82,000 BPD

in five years. This annual increase of 16,400 BPD has been used to extrapolate the demand requirements in Montreal for Alberta crudes through 1969.

Requirements past 1969 are not estimated and further throughput projection is not attempted herein. Certainly intra-Canadian growth in the prairie provinces, the Toronto, Northern Ontario and Maritime areas, and even the possibility of crude oil export could eventually influence the ultimate pipeline throughput requirements.

Therefore, in order to maintain realistic premises, the engineering and economic studies herein do not consider the throughput buildup after 1969. An exception to this hypothesis occurs only as a secondary consideration of the 34-inch Main Line alternate, which can economically attain a throughput of 550,000 BPD. This alternate is developed under Section D, Design Calculations.

In summary, the throughputs in annual increments as herein developed are tabulated below. The daily rates shown would require 365-day continuous pumping, which is impractical in actual operation. Design throughputs, derived later in the report, allow about seven days per year, or two percent of the time, for emergency and routine shutdowns for maintenance and overhaul of the system.

| Year | Throughput, BPD* |
|---|---|
| 1960 | 200,000 |
| 1961 | 224,000 |
| 1962 | 248,000 |
| 1963 | 272,000 |
| 1964 | 296,000 |
| 1965 | 320,000 |
| 1966 | 336,400 |
| 1967 | 352,800 |
| 1968 | 369,200 |
| 1969 | 385,600 |

* Multiply by 365 to obtain annual rates.

## 2. DISCUSSION OF SUPPLY

The Levy report (Page 1-7) shows a surplus for 1957 between Alberta's productive capacity and actual production to meet demand, of about 370,000 BPD (50 percent of capacity). The report further states (Page iii) that by 1965 the gap is likely to be some 500,000 BPD. Discoveries northwest of Edmonton are also to be considered. The work of other consultants can also be used to fully substantiate the Alberta supply as more than adequate to meet Montreal demands without jeopardizing present markets for Alberta crude.

A presently insignificant consideration is that the route of the proposed pipeline intersects the Westspur pipeline in Eastern Saskatchewan. South Saskatchewan crudes now have marketing outlets but new discoveries in the future could utilize the proposed system if other marketing facilities were operating above economic capacity.

It is definitely not the function of the Alberta-Montreal pipeline to compete with other pipeline systems presently installed or compete in the markets served thereby. But the proposed pipeline could in the future relieve existing facilities of excessive capacities at uneconomical operation, providing the economic capacity of the proposed system is sufficient.

Extensive study by others has furnished for this report a distribution of sources of the throughput from the various Alberta fields. Heavier Alberta crudes, below about 38° API, were favored for initial operations to correlate with the demand of present Montreal refineries. Economics of gathering was also considered in these assumptions in the interest of effectiveness of the overall system.

After consideration of these two points, the deficit between present allowable production and productive capacity was noted for the fields to determine surplus capacity geographically. Laterals from Edmonton and Calgary to a common point at Bellshill Lake appeared to present a feasible gathering system. The Calgary Lateral would receive the major portion of its stream about midway to Bellshill Lake, from the present Britamoil pipeline.

It is assumed that the Britamoil pipeline would deliver volumes from fields including Drumheller, West Drumheller, Wayne, Fenn-Big Valley, Stettler and some smaller fields. The Calgary Lateral stream would be augmented to a relatively small degree by flow from Calgary. The throughput from Calgary would represent surplus over Calgary requirements, and originate from Harmattan, Harmattan East, Westward Ho, Sundre and possibly other fields, delivered to Calgary via the Cremona pipeline. A small volume would be injected directly at Bellshill Lake from Bellshill Lake Field

which contains a preferred heavy gravity crude.

Deliveries to Edmonton have been based on the incremental production from these major fields: Pembina, Leduc, Redwater, Acheson, and Golden Spike. The Texaco stream initially excluded from consideration because of high gravity, would probably be added to shipments as refinery capacity permits. The Peace River steam has been considered as being devoted to the Trans-Mountain pipeline. Pembina has been used to compensate for the exclusion of these two streams.

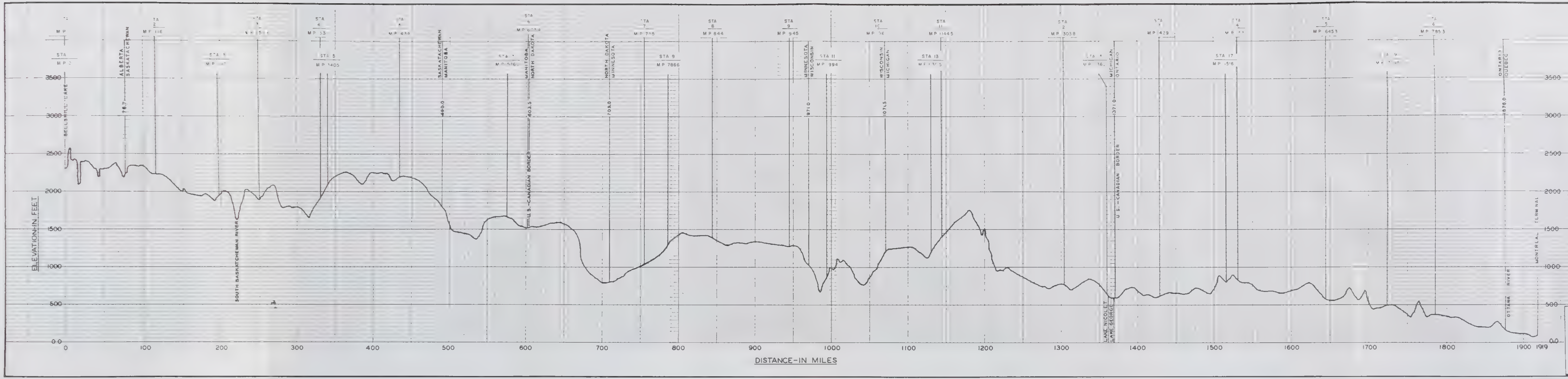
The Pembina stream as used in this report would include production from new fields mainly north and northwest of Edmonton such as Swan Hills, Red Earth, etc. Such new and future discoveries would reduce the balancing demand on the Pembina field.

The term, Alberta Light, has been used to denote Leduc, Acheson, Golden Spike and other light crude streams flowing to Edmonton. It is assumed that three crudes would be batched out of Edmonton - Pembina (including Swan Hills), Redwater and Alberta Light. Based on prorated production capacity figures, these crudes would be batched in the following proportions:

| | |
|---|---|
| Pembina | 39.5% |
| Redwater | 37.5% |
| Alberta Light | 23.0% |

All streams from Calgary and Britamoil will be comingled to Bellshill Lake.

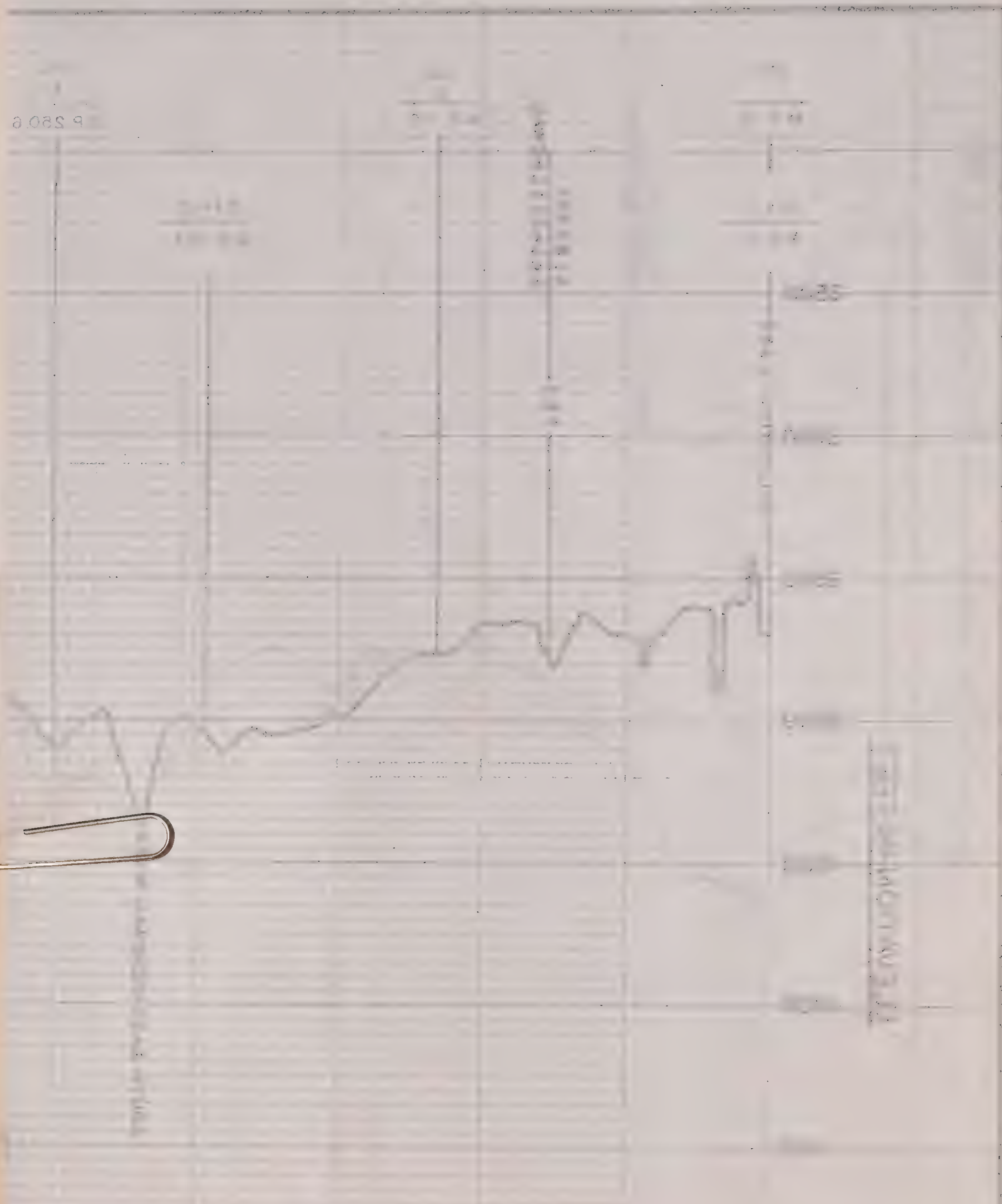
A Throughput Development Chart, Exhibit 3, appears on the following page. The chart shows the amount of throughput from each source for each of the ten years considered. This chart represents the basis for ensuing hydraulic calculations.

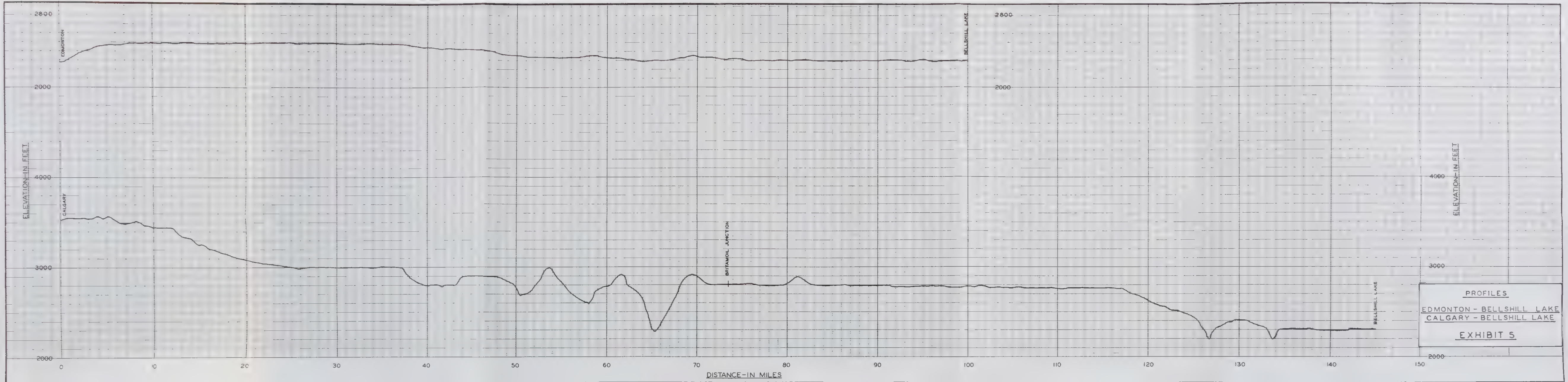



PROFILE

BELLSHILL LAKE - MONTREAL

EXHIBIT 4





ELEVATION - IN FEET
2800
2000
4000
3000
2000
EDMONTON
BELLSHILL LAKE
CALGARY
BRITAMOIL JUNCTION
BELLSHILL LAKE
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
DISTANCE - IN MILES
PROFILES
EDMONTON - BELLSHILL LAKE
CALGARY - BELLSHILL LAKE
EXHIBIT 5

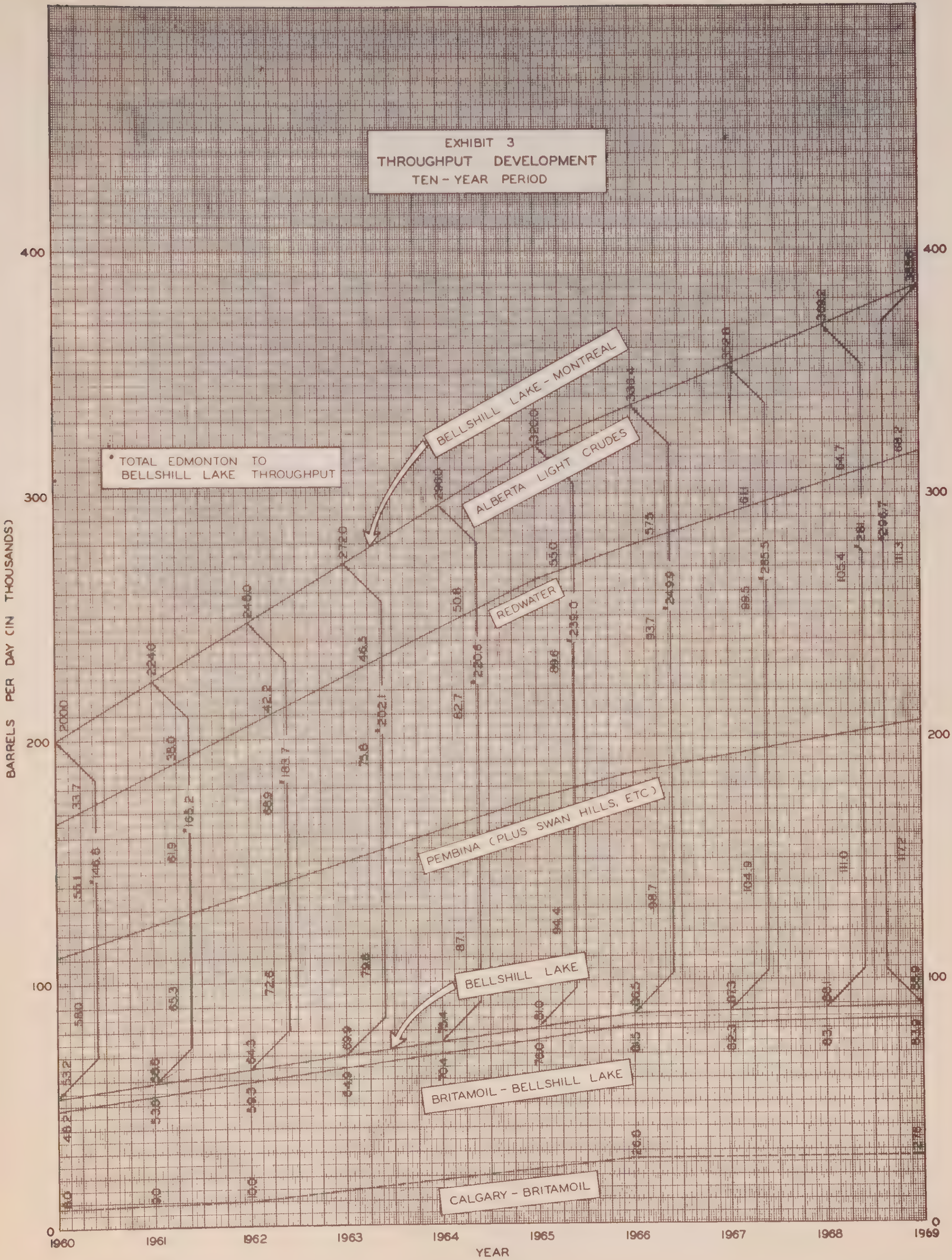


EXHIBIT 3
THROUGHPUT DEVELOPMENT
TEN - YEAR PERIOD
* TOTAL EDMONTON TO BELLSHILL LAKE THROUGHPUT
BELLSHILL LAKE - MONTREAL
ALBERTA LIGHT CRUDES
REDWATER
PEMBINA (PLUS SWAN HILLS, ETC)
BELLSHILL LAKE
BRITAMOIL - BELLSHILL LAKE
CALGARY - BRITAMOIL
BARRELS PER DAY (IN THOUSANDS)
YEAR
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
0
100
200
300
400


EXHIBIT 3

## 3. GATHERING AND TERMINAL FACILITIES

It is assumed that all throughput will enter the system through existing pipelines except for the minor amounts (5,000 BPD) injected directly at Bellshill Lake. The Calgary stream enters through the Cremona pipeline, the Britamoil stream through the Britamoil pipeline, and the Edmonton stream through three existing lines via short connecting lines. Therefore, no significant gathering facilities need be installed, except for the respective pump stations and tankage.

Major tank farms are required at Edmonton and Bellshill Lake since three grades of crude oil are batched in and out of Edmonton, and four grades in and out of Bellshill Lake. Small tankage is required at Calgary, and at Britamoil Junction to comingle the incoming streams for further transmission. Calculation of tankage requirements is shown under Section E, Description of Proposed Facilities.

Batching of four grades of crude oil allows selective receipt of any grade by each of the Montreal refineries. A manifold would be located at a central point between refineries, with a transfer pipeline of about two miles average length laid to each refinery. Custody transfer would occur at the manifold by use of positive displacement meters.

## 4. SELECTION AND DESCRIPTION OF ROUTE

Since the proposed pipeline serves no intermediate points between Bellshill Lake and Montreal, the most direct route between the two points would in general effect the minimum of cost and resulting tariff. Some deviation is economically warranted to avoid rocky or rough terrain or populated areas where construction costs are excessive. In addition, consideration is given to accessibility of the traverse by road for maintenance or emergency repairs.

After the basic route was selected, the traverse was further defined by aerial and ground reconnaissance and a careful study of large-scale topographic maps. Areas such as the water crossings at Sault Saint Marie were given particular attention at the site to determine an economic routing and realistic cost estimate for construction.

The shortest and most economical route derived is shown as a solid line on the Route Map, Exhibit A, in the front of the report. This route is termed the Southern Route, and passes partially through the United States. United States passage should not affect throughput expenses, since the oil would travel in bond from border to border without tankage. It is understood no United States transportation tax would be effected as long as no tankage is installed in the States.

An alternate, or Northern Route, is also shown on the Route Map which does not cross the international border. This route is approximately 115 miles longer than the Southern Route, and crosses an area of about 800 miles of solid rock terrain. This stretch is sparsely populated and would entail excessive construction and maintenance costs. Alternate costs and required tariffs are presented in Chapter II for both routes.

The profiles of the two lateral lines terminating at Bellshill Lake are shown on Exhibit 5 following this section. The Calgary Lateral traverses relatively flat farm land from its origin near Calgary to the Britamoil Junction at Milepost 73. 5. The Red Deer River is crossed at Milepost 65. At this point the river valley is approximately 5 miles wide and 600 feet deep. Some heavy grading will be required at the edges of the valley.

From Britamoil Junction to Bellshill Lake at Milepost 145 the route crosses flat farm and grazing land with some light brush. Small ponds and sloughs are numerous in this area but should present no construction difficulty.

The Edmonton Lateral passes through farm and grazing land with some small sloughs and light brush from its origin to about Milepost 50. From Milepost 50 the route is relatively flat, mostly farm land with a small amount of brush. The Edmonton Lateral terminates at Bellshill Lake at Milepost 100.

Exhibit 4 shows the profile of the Main Line for the Southern Route. The Alberta portion of the Main Line traverses flat farm and grazing land with light brush and some small ponds and sloughs. The Alberta border is crossed at Milepost 76.7.

The Saskatchewan portion of the Main Line crosses farm land with occasional ponds and sloughs. The South Saskatchewan River is crossed near Milepost 215 and this crossing is considered a major underwater crossing. The route also crosses numerous small streams and creeks, none of which will present any construction difficulties. The Saskatchewan-Manitoba border is crossed at Milepost 490.

The route crosses the southwest corner of the Province of Manitoba, an area of mostly farm land with a small amount of brush. No construction difficulties are expected in crossing the small streams in this area. The Manitoba-North Dakota border is crossed at Milepost 603.5.

The North Dakota portion of the Main Line crosses flat farm land with very little tree cover and with occasional small creeks. This section ends at the Red River crossing at Milepost 709 which is the North Dakota-Minnesota border. This river crossing is not considered a major river crossing.

The Minnesota portion of the route extends from Milepost 709 to Milepost 971. The western part of this section is flat farm land, the remaining portion is swampy with numerous lakes and streams.

The Wisconsin section extends to Milepost 1071.5 and crosses an area with some farm land, some tree cover and numerous streams flowing north into Lake Superior.

The Michigan section, from Milepost 1071.5 to Milepost 1370 crosses a small amount of farm land, the remainder consisting of wooded areas with a great many lakes and swamps. Some solid rock area will be crossed in western Michigan. Lake Nicolet below Sault Ste. Marie is approximately one mile wide and 25 feet deep at the point of crossing. The International Boundary is crossed in Lake George at Milepost 1370. This crossing is approximately one-half mile wide and thirty feet deep.

The Ontario section of the route extends from Milepost 1370 to Milepost 1876.5. Rock will be encountered throughout this section with practically solid rock terrain near and east of Sudbury. Difficult construction is expected between Lake George and Pembroke with most difficulty expected near Sudbury. From Pembroke to the Quebec border near Point Fortune the route traverses farm land with small quantities of brush and swampy areas.

The Quebec part of the route is primarily farm land. This section includes the Ottawa, Mille Iles and Prairie River Crossings. Rock excavation is expected in these river crossings.

The route terminates near the refinery area of Montreal at Milepost 1919.

## C. DESIGN PREMISES

### 1. CLIMATIC CONDITIONS

Climatic conditions along the route affect the system in many ways--in design, construction, and maintenance. A careful analysis is particularly important for this pipeline system, since the fluid to be pumped bears a marked increase in viscosity with decreasing temperatures. Climatic conditions affect not only the hydraulic throughput of the line, but also affect the selection and preparation of equipment, and the periods of construction and maintenance.

The chart on the following page, Exhibit 6, presents climatic data for Regina as obtained from the Department of Transport. The succeeding chart, Exhibit 7, shows mean annual temperature isotherms across Canada. Exhibit 7 illustrates that the mean temperature is approximately the same ($35^{\circ}$ F) across the traverse, with but slightly warmer conditions ($40^{\circ}$ F) on the eastern end. A comparison of hythergraphs showing monthly precipitation and temperature for various cities along the route determines that Regina represents average weather conditions.

Regina, as shown by Exhibit 6, has an extreme range of temperatures, varying from an average daily high temperature of $79^{\circ}$ F in July to an average daily low temperature of $-11^{\circ}$ F in January -- with recorded extremes of $107^{\circ}$ F and $-56^{\circ}$ F.

Average temperatures are below freezing from November through March, effecting considerable handicap and additional expense for outside construction work during this period. Design must be adequate for this period to protect liquid cooled equipment, and provide sufficient heat for process and personnel requirements.

Average annual snowfall amounts to only 29 inches, which is a consideration in the design of roof loads for buildings. Total precipitation for the year averages only 15 inches, indicating a relatively dry climate and ease of pipeline maintenance. The hythergraph for Kapuskasing, Ontario, which lies near the Northern Route, shows an annual rainfall of about 28 inches but very similar temperatures to Regina.

Temperatures below ground are important in pipeline hydraulic calculations, since temperature affects viscosity which in turn affects the pressure required to effect a given flow, and the resulting horsepower required. Above ground temperatures naturally affect underground temperatures, but the extent is dependent upon not only the depth considered but also upon the cohesiveness, void ratio, and percolation rate of the soil.

## REGINA, SASK.—50°26′N. 104°39′W. 1,884 FEET ABOVE SEA

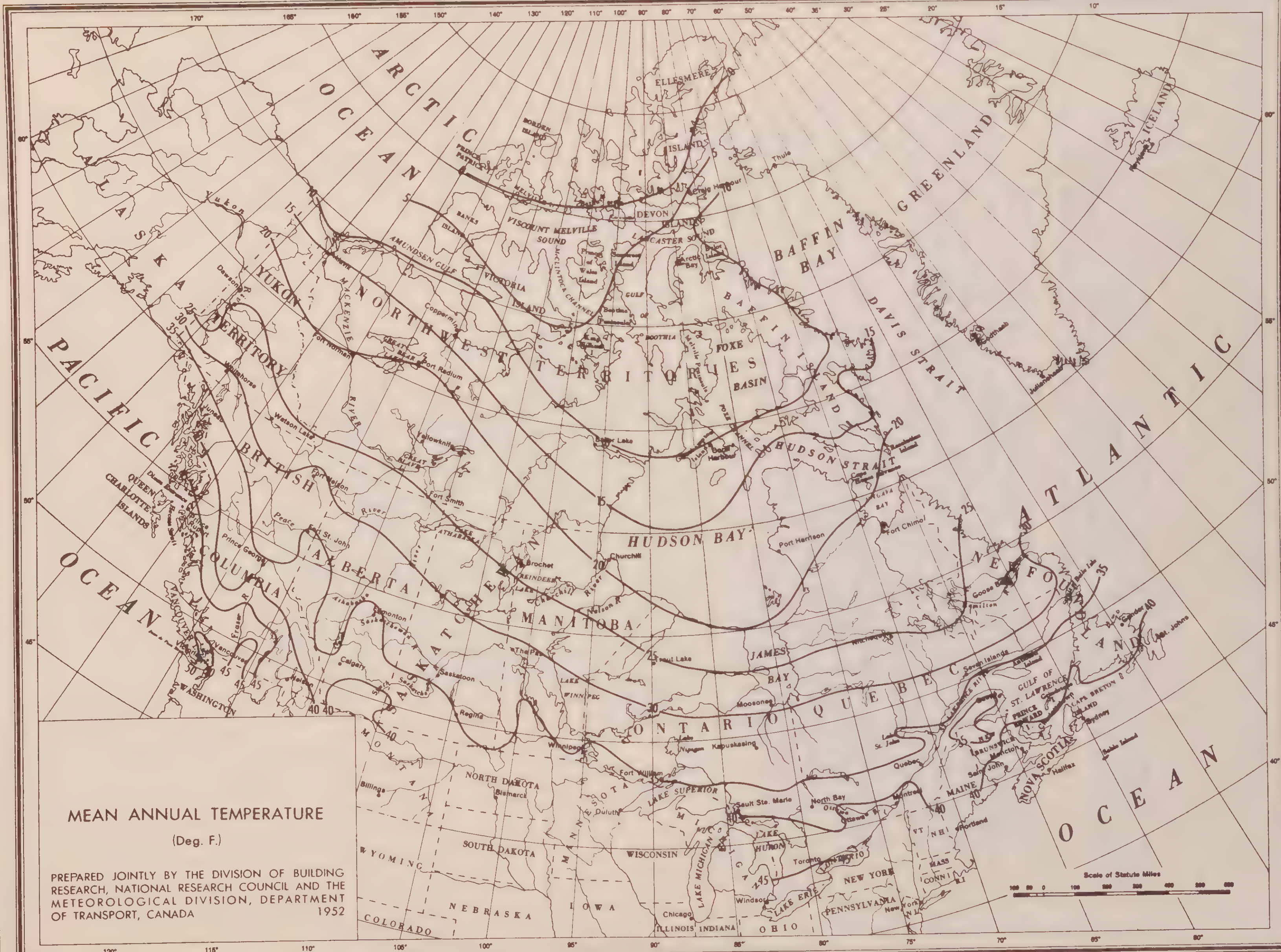
| | Temperature | | | | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average Daily | | | Extremes | | | | Rain | | Snow | | Total Precipitation (water) |
| | | | | Average | | Record | | | | | | |
| | Mean | High | Low | High | Low | High | Low | Inches | Days | Inches | Days | |
| | °F. | °F. | °F. | °F. | °F. | °F. | °F. | No. | No. | No. | No. | in. |
| Jan..... | 0·7 | 9·5 | −10·9 | 36 | −38 | 48 | −54 | 0·04 | 1 | 4·7 | 8 | 0·51 |
| Feb..... | 2·0 | 12·6 | −8·6 | 37 | −35 | 53 | −56 | 0·01 | [1] | 3·4 | 13 | 0·35 |
| Mar..... | 16·5 | 26·9 | 6·1 | 47 | −22 | 76 | −44 | 0·13 | 1 | 5·4 | 9 | 0·67 |
| Apr..... | 37·8 | 49·7 | 26·0 | 73 | 5 | 89 | −20 | 0·44 | 5 | 3·0 | 3 | 0·74 |
| May..... | 51·0 | 64·8 | 37·1 | 85 | 20 | 99 | 7 | 1·78 | 8 | 0·6 | 1 | 1·84 |
| June..... | 60·2 | 73·2 | 47·2 | 90 | 32 | 102 | 23 | 3·24 | 12 | 0·1 | [1] | 3·25 |
| July..... | 64·8 | 78·9 | 50·8 | 93 | 38 | 107 | 28 | 2·38 | 11 | Nil | Nil | 2·38 |
| Aug..... | 62·2 | 76·9 | 47·6 | 92 | 34 | 104 | 23 | 1·76 | 9 | Nil | Nil | 1·76 |
| Sept..... | 51·4 | 64·9 | 38·0 | 85 | 21 | 99 | 9 | 1·26 | 6 | 0·6 | [1] | 1·32 |
| Oct..... | 39·4 | 51·8 | 27·0 | 75 | 8 | 87 | −15 | 0·63 | 4 | 2·3 | 2 | 0·86 |
| Nov..... | 21·3 | 31·6 | 11·0 | 55 | −14 | 73 | −47 | 0·12 | 1 | 4·8 | 9 | 0·60 |
| Dec..... | 7·6 | 16·4 | −1·3 | 41 | −29 | 59 | −55 | 0·03 | 1 | 3·9 | 9 | 0·42 |
| **Year....** | **34·5** | **46·4** | **22·5** | **96** | **−42** | **107** | **−56** | **11·82** | **59** | **28·8** | **54** | **14·70** |

| | Heating Factor | Wind | | | | | Thunder | Bright Sunshine | Frost[2] | Humidity | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day-Degrees Below 65°F. | Most Prevalent | | Second Prevalent | | Average Speed | Days with | Hours of | Days with | Water-Vapour (parts per 1,000) | Relative | |
| | | Direction | Percentage | Direction | Percentage | Miles per Hour | | | | | 24-Hour | Noon |
| | No. | | | | | | No. | No. | No. | | p.c. | p.c. |
| Jan..... | 2,037 | SE. | 24 | W. | 23 | 12·0 | Nil | 108 | 31 | 1·0 | 89 | 86 |
| Feb..... | 1,818 | SE. | 26 | W. | 19 | 12·1 | Nil | 126 | 28 | 1·1 | 91 | 88 |
| Mar..... | 1,504 | SE. | 23 | NW. | 18 | 13·2 | Nil | 163 | 31 | 1·9 | 87 | 83 |
| Apr..... | 816 | SE. | 24 | NW. | 16 | 13·9 | [1] | 216 | 23 | 3·7 | 70 | 60 |
| May..... | 434 | SE. | 19 | E. | 19 | 14·0 | 2 | 252 | 6 | 5·3 | 60 | 47 |
| June..... | 174 | E. | 18 | SE. | 17 | 13·4 | 3 | 244 | [1] | 7·7 | 69 | 57 |
| July..... | 48 | W. | 18 | SE. | 18 | 11·4 | 5 | 329 | Nil | 9·7 | 68 | 54 |
| Aug..... | 92 | SE. | 21 | W. | 17 | 12·3 | 4 | 285 | Nil | 8·6 | 65 | 52 |
| Sept..... | 408 | W. | 20 | SE. | 19 | 12·6 | [1] | 205 | 4 | 6·0 | 69 | 56 |
| Oct..... | 794 | SE. | 24 | W. | 23 | 12·9 | Nil | 170 | 17 | 4·3 | 70 | 58 |
| Nov..... | 1,355 | SE. | 26 | W. | 21 | 13·0 | Nil | 98 | 30 | 2·0 | 88 | 83 |
| Dec..... | 1,779 | SE. | 27 | W. | 21 | 12·1 | Nil | 98 | 31 | 1·3 | 88 | 84 |
| **Year....** | **11,259** | **SE.** | **22** | **W.** | **18** | **12·7** | **14** | **2,294** | **201** | **4·4** | **76** | **67** |

[1] Less than 5 days in 10 years.  [2] Average date of last spring frost June 6; of first fall frost Sept. 10.

# REGINA CLIMATIC DATA

EXHIBIT 6




MEAN ANNUAL TEMPERATURE

(Deg. F.)

PREPARED JOINTLY BY THE DIVISION OF BUILDING RESEARCH, NATIONAL RESEARCH COUNCIL AND THE METEOROLOGICAL DIVISION, DEPARTMENT OF TRANSPORT, CANADA 1952

EXHIBIT 7

The seasonal variation of soil temperatures moderates at increasing depths, so that higher minimum temperatures are obtained in a pipeline the deeper it is buried. However, construction costs are somewhat proportional to the depth of ditch, so that an economic balance must be attained. It has been assumed that the proposed system would have 36 inches of cover in soil and 20 inches of cover in rock. Therefore, the average depth of centerline of pipe for the Main Line would be about 52 inches in soil and 36 inches in rock.

Many studies were examined of soil temperatures in areas analogous to the traverse proposed. Exhibit 8 on the following page is believed representative for the traverse. The curve shows the great temperature advantage of burying the pipe from three to four feet deep to the centerline. The advantage decreases with increasing depth.

On the basis of Exhibit 8, the minimum flowing temperature of the crude oil would be about $30^{\circ}$ F, and a maximum of $54^{\circ}$ F. A conservative average design temperature of $35^{\circ}$ F was selected. Thus flow should exceed design throughput most of the year, with the possibility of slightly less than design throughput occurring during the coldest periods.

SOIL TEMPERATURE
AT VARIOUS DEPTHS

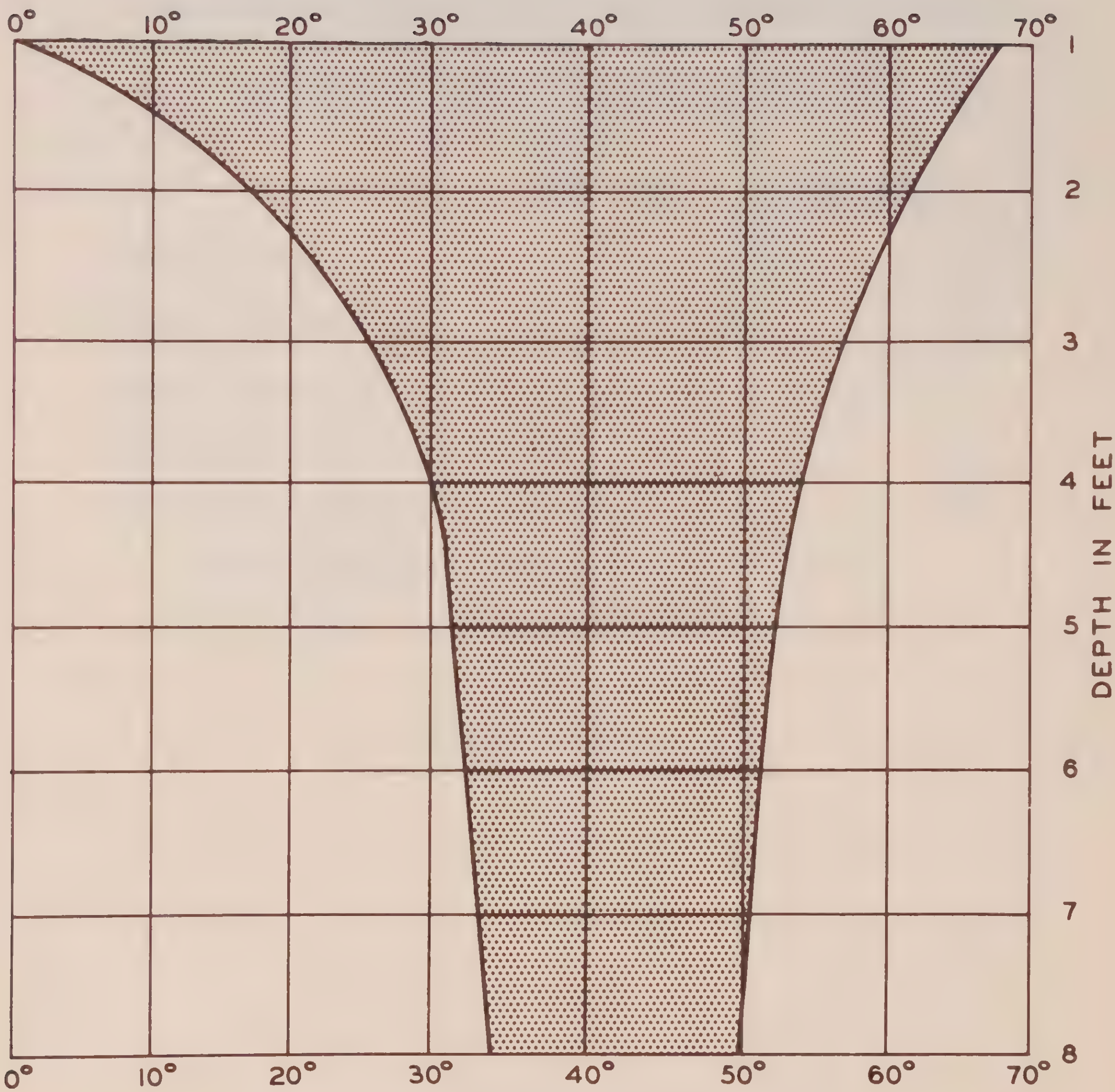



EXHIBIT 8

## 2. CRUDE OIL CHARACTERISTICS

Physical properties of the crude oil have a marked effect on the hydraulic design of the system. Such properties include viscosity, gravity and pour point. The pour point of all oils considered appears well below the minimum flowing temperature anticipated and thus may be disregarded in this study.

Viscosities and gravities were obtained for the oils from all fields anticipated to contribute to the throughput. Where oils were to be comingled during flow, the respective viscosities were blended appropriately to derive a representative figure. Specific gravities were averaged according to the proportion of each oil comingled. Both viscosities and gravities were converted to the design flowing temperature of 35°F. Results are as follows:

| | At 35°F | |
|---|---|---|
| Pipeline Sections | Gravity API° | Viscosity SSU |
| Edmonton-Bellshill Lake | 33.8 | 118 |
| Calgary-Britamoil Junction | 33.3 | 71 |
| Britamoil Junction - Bellshill Lake | 31.4 | 193 |
| Bellshill Lake - Montreal | 33.3 | 130 |

These values were used in hydraulic calculations.

## 3. DESIGN THROUGHPUT

As previously related, throughputs shown on the foregoing Throughput Development Chart represent average daily values for 365 days per year. Since some time must reasonably be reserved for shut-down time to accommodate emergency repairs and maintenance, throughput must be increased the remainder of the time to produce the average daily figures. It is assumed that the pipeline will operate 98 percent of the time, allowing about seven days per year for shut-downs. Therefore, average throughput on an annual basis has been divided by 98 percent to result in the design throughputs shown below.

| Year | Throughput, BPD, for Pipeline Section Calgary - Britamoil Jct. | Britamoil Jct. - Bellshill Lake | Edmonton - Bellshill Lake | *Bellshill Lake - Montreal |
|---|---|---|---|---|
| 1960 | 8,160 | 49,200 | 149,700 | 204,000 |
| 1961 | 9,180 | 54,900 | 168,500 | 228,000 |
| 1962 | 10,200 | 60,500 | 187,400 | 253,000 |
| 1963 | 14,500 | 66,200 | 206,100 | 277,000 |
| 1964 | 18,800 | 71,800 | 225,000 | 302,000 |
| 1965 | 23,000 | 77,500 | 243,800 | 326,000 |
| 1966 | 27,400 | 83,100 | 254,900 | 343,000 |
| 1967 | 27,600 | 83,900 | 270,800 | 360,000 |
| 1968 | 27,900 | 84,800 | 286,700 | 377,000 |
| 1969 | 28,200 | 85,600 | 302,600 | 393,000 |

*Includes 5,100 BPD injected at Bellshill Lake.

formulas based on empirical data. For this study, the various C values were selected from large charts empirically derived, for purposes of accuracy. Values ranged from C = 0.0211 for a Q of 17,000 BPH and d of 29.125'' to C = 0.0344 for a Q of 400 BPH and d = 10.25''.

From the above formulae, the pressure loss per mile of pipeline for various throughputs and pipe diameters was plotted to aid in further calculations. The more pertinent of the resulting charts, Exhibits 9 through Exhibit 12, follow. Alternate pipe sizes were selected for each pipeline section and economically compared, with allowance for throughput growth and some flexibility between laterals. Pipe diameters of 10-3/4'' OD, 16'' OD, and 26'' OD were selected for the laterals from Calgary, Britamoil Junction and Edmonton respectively.

Diameters of 26'', 30'' and 34'' were initially considered for the Main Line, but the 26'' size was considered comparatively uneconomical after the second year throughput of 228,000 BPD. Therefore, detailed analyses were made for 30'' and 34'' sizes. Any intermediate size could be rolled on special order.

## FRICTION LOSS CURVE
## CALGARY – BRITAMOIL JUNCTION

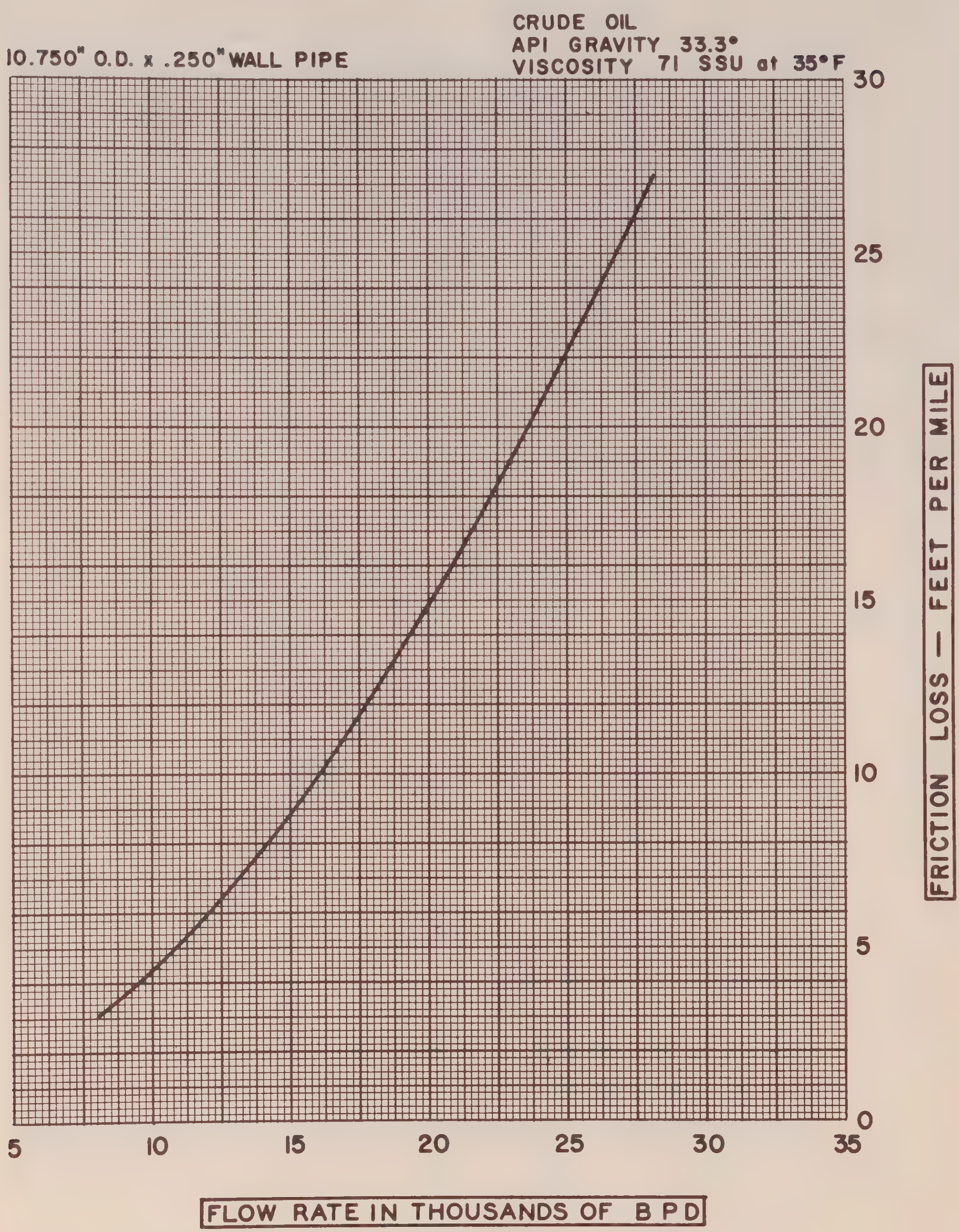



EXHIBIT 9

# FRICTION LOSS CURVE
## BRITAMOIL JCT.–BELLSHILL LAKE

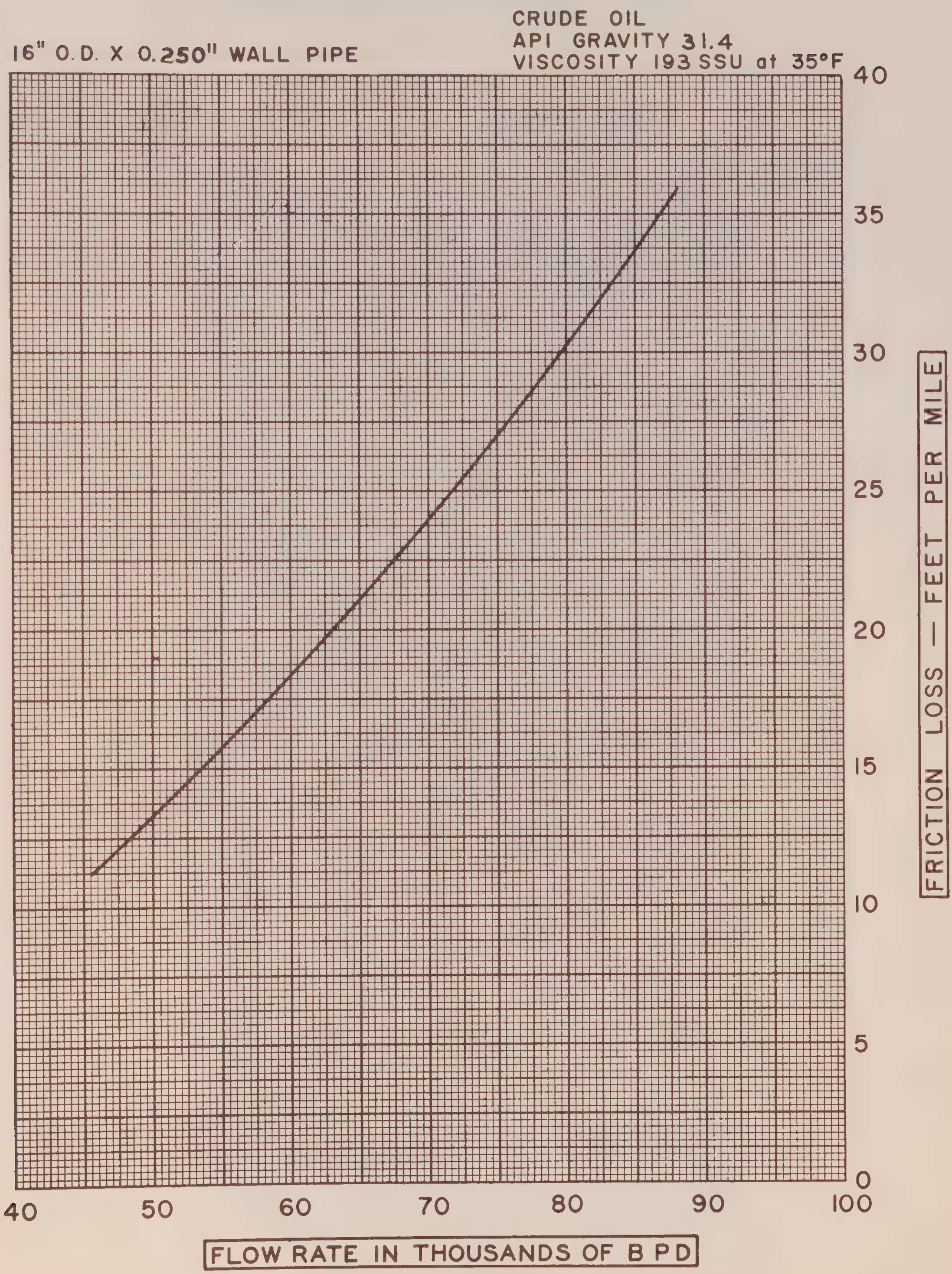



EXHIBIT 10

FRICTION LOSS CURVE

EDMONTON - BELLSHILL LAKE

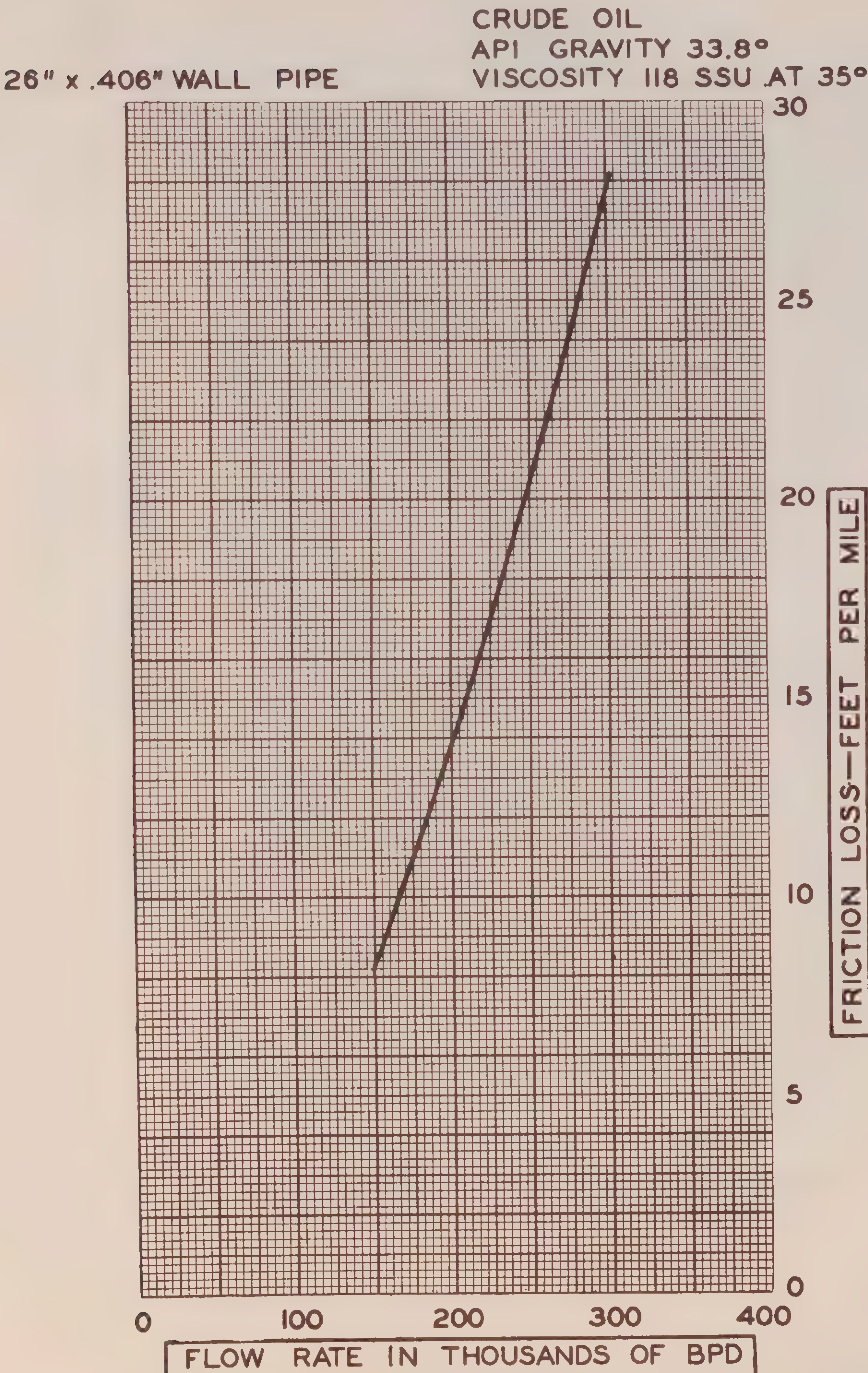



EXHIBIT II

# FRICTION LOSS CURVES
## BELLSHILL LAKE - MONTREAL

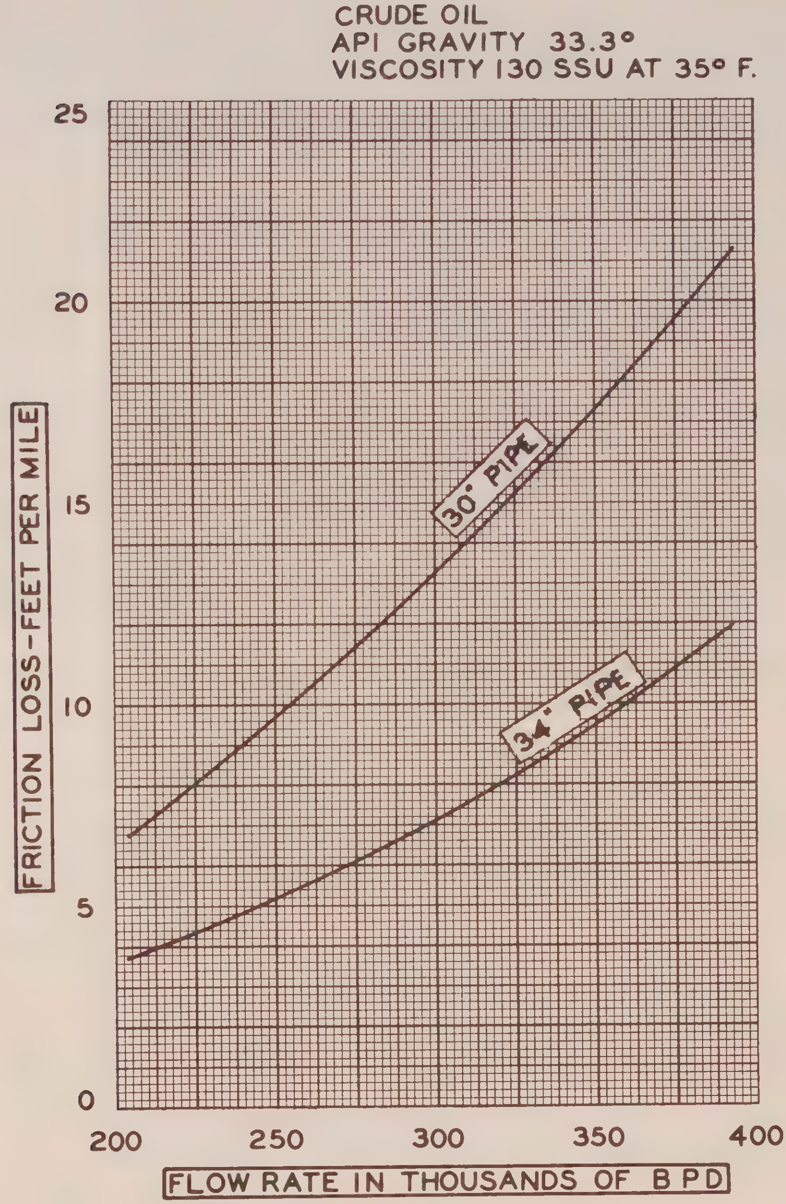



EXHIBIT 12

## 2. SYSTEM DESIGN

The economic optimum diameter for a crude oil transmission line of given throughput depends on many variables -- such as line length, oil properties, traverse profile, pump station location, operating pressure, allowable pipe stress.

As a rule-of-thumb, however, the friction loss per mile is a reasonable basis for preliminary diameter selection. For a crude oil of the properties corresponding to this study, the economic optimum condition may be very generally expressed by the rule-of-thumb formula:

$$P/L = 13 - \frac{D}{4}$$

where P/L is the pressure drop in psi per mile, and D is the OD of the pipe.

Friction loss design values lower than optimum values usually produce much more economic results than values correspondingly higher. Therefore, for systems expecting throughput growth, it is desirable that friction loss values for initial years of operation be considerably below optimum values. These premises have been developed from detailed engineering and economic studies comparing alternate systems.

A rule-of-thumb for economic optimum working pressure may be expressed as

$$P = 1250 - 15D$$

where P is maximum working pressure in psi, which occurs at pump station discharge when the traverse is fairly level.

### a. Pipe Specifications

For large-diameter long-distance transmission lines significant savings result by designing and operating the system at the maximum allowable working stress of the pipe. This is of course true since steel that is not used to its safe capacity represents wasted investment. On this project, each thirty-second of an inch of pipe wall thickness costs approximately $15, 000, 000.

In designing this system wherein the smallest diameter selected is 10-3/4" OD, a minimum wall thickness of 0.250" is recommended. This limit is empirically established in the interests of overall economy, as lesser thicknesses are

subject to considerable damage in handling pipe and complications in welding. Hidden handling damage or weld defects may result in a costly maintenance program and loss of product due to leaks, years after installation.

Four grades of pipe are commonly used for pipelines in accordance with API Standards 5L and 5LX, for line pipe and high-test line pipe respectively. These grades are Grades B, X-42, X-46 and X-52. They vary in chemical properties and yield strength. Minimum yield strenghs according to code are: Grade B, 35,000 psi; X-42, 42,000 psi; X-46, 46,000 psi; and X-52, 52,000 psi.

Thus X-52 pipe is 49 percent stronger than Grade B; and it costs only a few percent more. X-52 pipe, however, is more brittle, and more difficult to satisfactorily weld in cold weather. Where extra strength is not essential, Grade B is preferred for its ductility. This is particularly true for crossings of swift rivers in sandy soil subject to erosion and possible pipe movement.

Maximum allowable working pressures for pipe used in cross-country oil pipelines are established by the ASA Code B 31.1, Section 3. Although it is not mandatory to follow this code in the area traversed, it has been used as representing good pipeline practice. The code modifies Barlow's formula to:

$$t = \frac{PD}{2S} + C$$

where t = design thickness of the pipe wall, in inches
P = maximum working pressure, in psi
D = OD of pipe, in inches
and C = corrosion allowance, in inches

The design thickness, t, must compensate for the manufacturer's tolerance--minus 12.5 percent by API Code. For seamless or electric-resistance-welded pipe, S equals 85 percent of the minimum yield strength. Although the pipe is to be adequately protected from corrosion, a corrosion allowance of 0.05 inches is used as good practice to compensate for minor defects incurred in manufacturing, handling and occasioned by holidays (weak spots) in the protective coating. Therefore, the code formula becomes:

$$t = \frac{PD}{(.875)\,2\,(.85S)} + .05, \text{ or } t = \frac{PD}{2 \times .744S} + .05$$

This expression relates that the pipe may be stressed to about 74.4 percent of yield, less corrosion allowance. For pipe sizes and thicknesses considered in this study, pipe may be stressed to roughly 64 percent of yield if the corrosion allowance of 0.05 inch is deducted.

Allowable working pressures based on the code formula and a corrosion allowance of .05 inch, in the range of sizes considered, are tabulated below:

| Pipe OD | Grade | Wall | Allowable Working Pressure |
|---|---|---|---|
| 10-3/4" | B | 0.250" | 934 psi |
| 16 | X-46 | 0.250" | 825 |
| | X-52 | 0.250" | 932 |
| 26 | X-52 | 0.438" | 1132 |
| | | 0.406" | 1037 |
| | | 0.375" | 945 |
| | | 0.344" | 853 |
| | | 0.312" | 758 |
| 30 | X-52 | 0.438" | 981 |
| | | 0.406" | 899 |
| | | 0.375" | 819 |
| | | 0.344" | 740 |
| | | 0.312" | 657 |
| 34" | X-52 | 0.438" | 866 |
| | | 0.406" | 793 |
| | | 0.375" | 723 |
| | | 0.344" | 653 |
| | | 0.312" | 580 |

All pipe should be ordered double-random length, with ends beveled 30 degrees for welding.

b. Hydraulic Calculations

Pertinent features of hydraulic design have been established, such as oil gravity and viscosity, throughput, pipe wall and diameter, and friction loss. From the profiles, Exhibits 4 and 5, the distance from Calgary to Britamoil Junction is 73.5 miles; from Britamoil Junction to Bellshill Lake, 71.5 miles; from Edmonton to Bellshill Lake, 100.0 miles; and from Bellshill Lake to Montreal, 1,919 miles via the Southern Route, and 2,034 miles via the Northern Route.

The required pressure at the upstream end of each pipeline lateral was calculated by (1) multiplying friction loss per mile for the design throughput by the lateral length in miles,

(2) allowing 37 to 50 psi for terminal losses through piping, valves, equipment and tank filling, and (3) compensating for the difference in elevation between the two ends of the lateral.

The resultant pressure in feet of head may be plotted on the respective profile as a vertical distance above the elevation of the upstream end. The suction pressure converted to feet may be plotted vertically at the terminal end. The slope of the line connecting the two plotted points coincides with the friction loss per unit of distance, and is termed the hydraulic gradient.

The pressure in the pipe at any point along the traverse is equal to the vertical distance between the hydraulic gradient and the ground elevation at the respective point.

Although this axiom relates to elementary hydraulics, it is basic to the frugal design of the main line system, as will be discussed.

Considering first the laterals, the profile presents a problem only near Calgary. A high point exists 5.3 miles from Calgary along the traverse to Britamoil Junction. Gravity flow from this point to the Junction would effect a delivery of about 15,900 BPD, which flow is not required until after 1963. This high point acts as a critical point from which the hydraulic gradient must be projected back to Calgary, until the throughput requirement exceeds 15,900 BPD. At that time, the hydraulic gradient would pass above the critical point, and the terminal elevation would control the required Calgary discharge pressure.

The charts on the following pages, Exhibits 13, 14 and 15, show the discharge pressure and brake horsepower required for each lateral at the flow rates under consideration. Brake (operating) horsepower has been calculated by the formula:

$$BHP = \frac{.0000171 \times BPD \times P}{e}$$

where P = discharge pressure less suction pressure, in psi
e = pump and gear efficiency

Pump and gear efficiency has been assumed as 80 percent. This figure may be slightly high for small pumps at lateral stations, but is conservative overall, since main line units will operate up to 87 percent efficiency. In most cases, installed horsepower in preliminary design is at least 10 percent greater than the required operating horsepower to prevent excessive wear and maintenance of the prime movers.

# PRESSURE - FLOW - HORSEPOWER CURVES

## CALGARY - BRITAMOIL JCT.

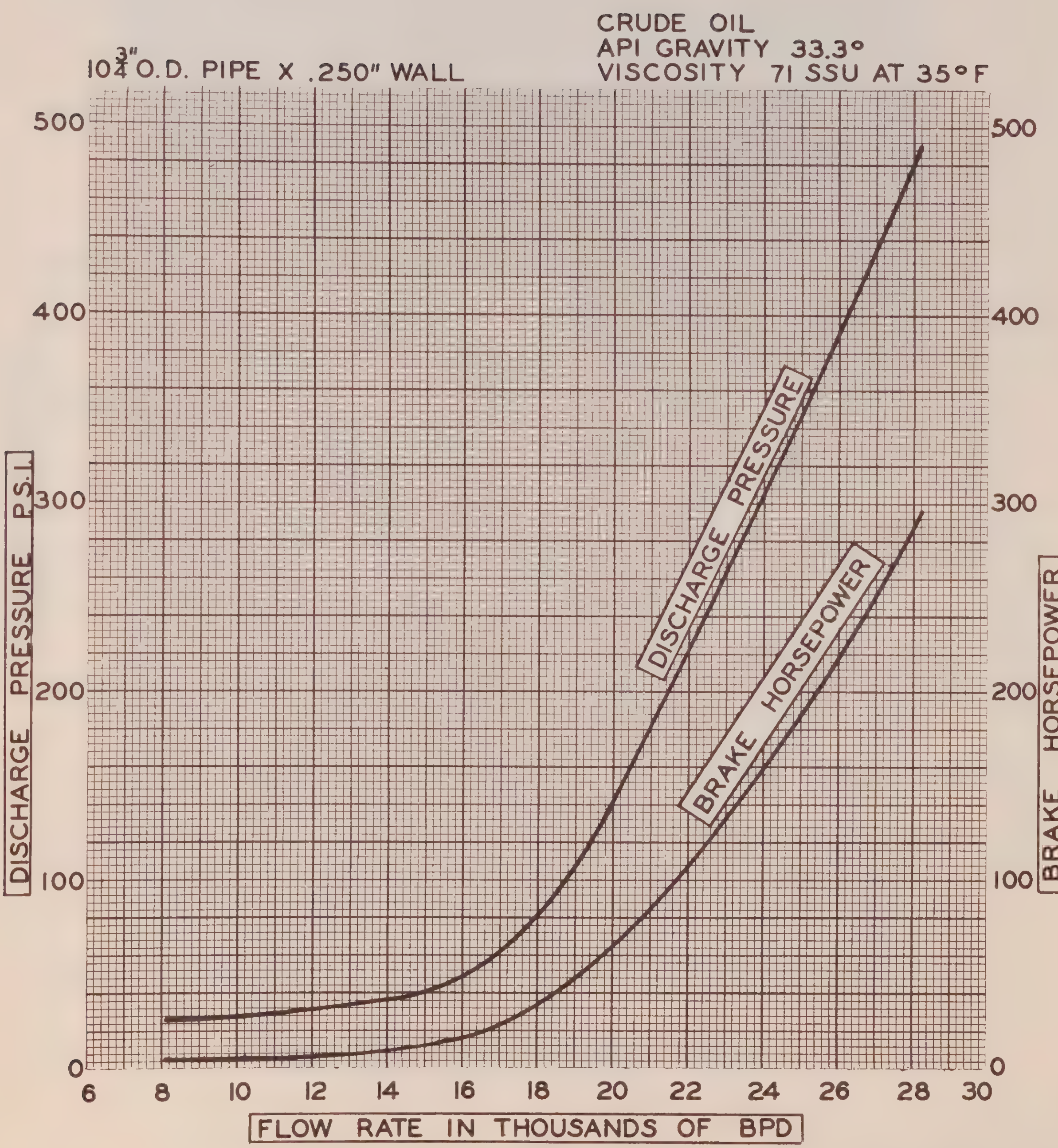



EXHIBIT 13

PRESSURE-FLOW-HORSEPOWER CURVES

BRITAMOIL JCT. - BELLSHILL LAKE

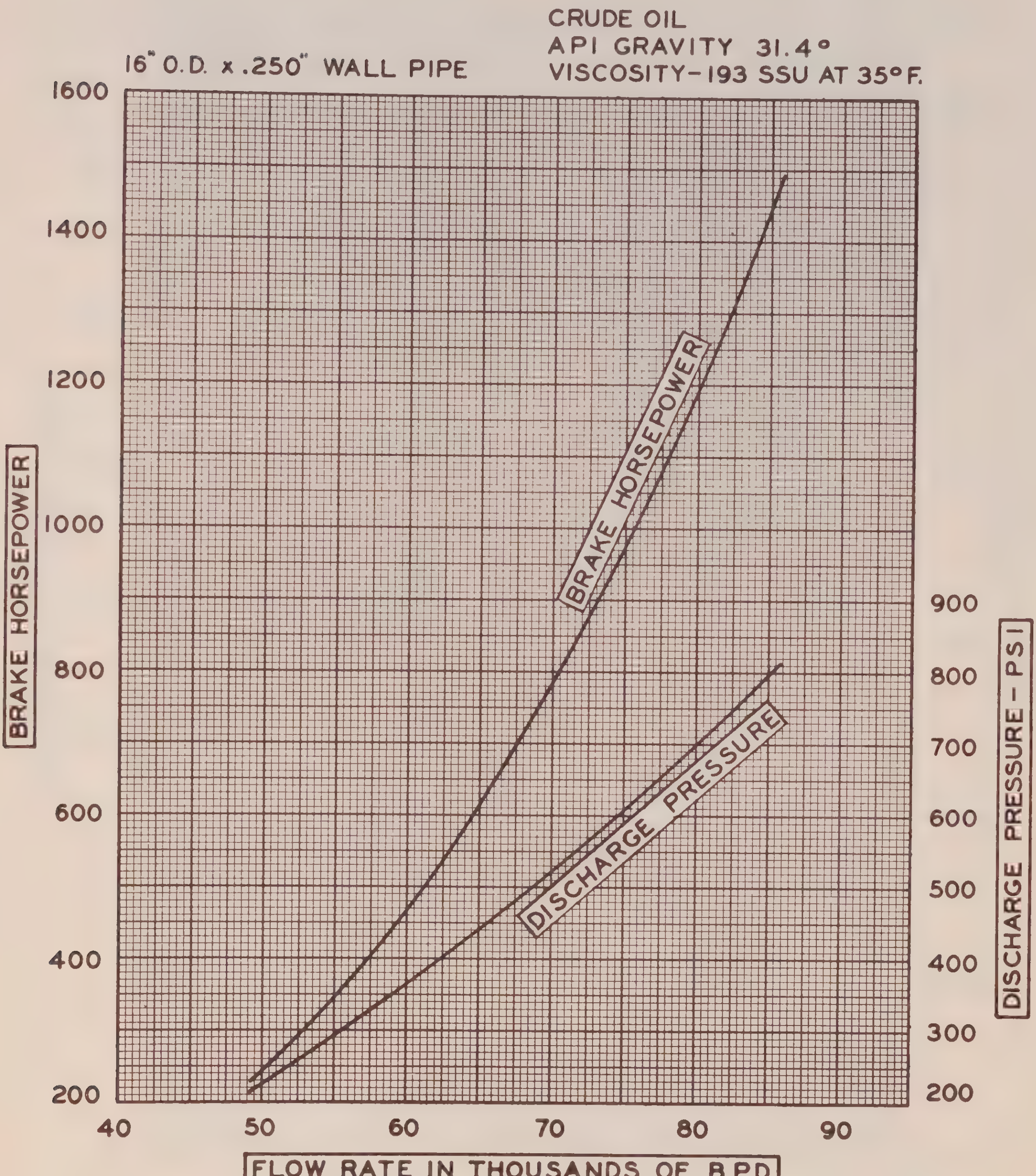



EXHIBIT 14

# PRESSURE-FLOW-HORSEPOWER CURVES
## EDMONTON-BELLSHILL LAKE

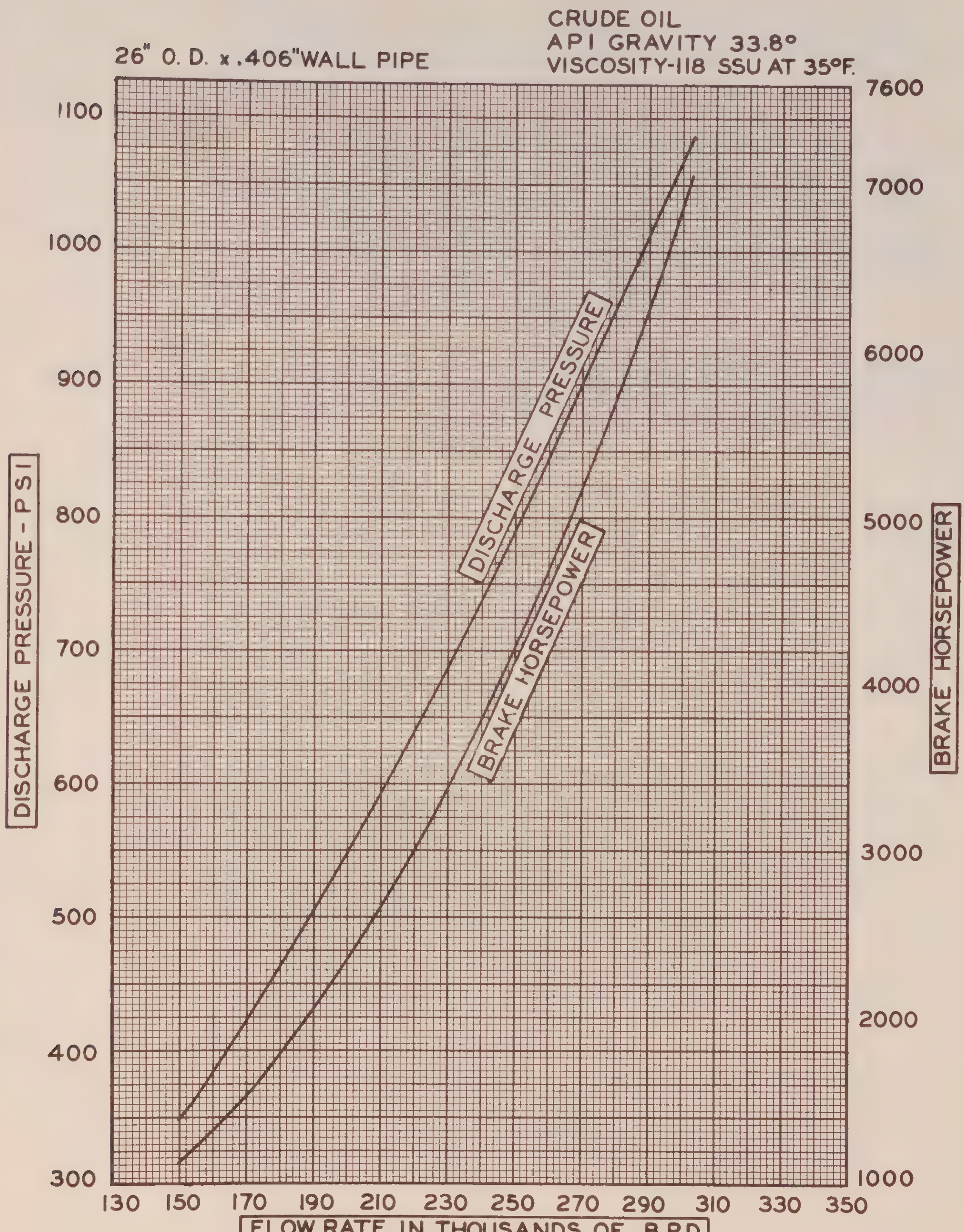



EXHIBIT 15

Main Line hydraulic studies were performed similarly to those for laterals. Preliminary studies show a 26-inch system as requiring too many pump stations with resulting excessive operating costs to make for an economic system with the throughput involved. Therefore, 30-inch and 34-inch systems were pursued for both the Northern and Southern Routes.

The total pressure required from Bellshill Lake to Montreal was calculated for the BPD throughput each year. Allowance was made for elevation differential and for 50 psi suction pressure at each pump station and the Montreal manifold. This suction allowance is liberal -- part of this pressure could be used to increase flow during the extremely cold periods when marked increases in viscosity occur.

The total pressure required for tenth year (1969) throughputs was divided by an even number to obtain a reasonable station discharge pressure in accordance with the previously stated rule-of-thumb,

$$P = 1250 - 15D, \text{ or } 800 \text{ psi for } 30'' \text{ pipe}$$
$$740 \text{ psi for } 34'' \text{ pipe}$$

The 50 psi suction pressure was added to each station discharge pressure, since only the differential affects the hydraulic gradient desired. An even number of stations is preferred so that alternate stations may be installed initially, and intermediate stations added when necessary as the throughput increases.

Eight stations were selected for the 30-inch Southern Route to be increased to 16 for 1963 throughput and beyond. Similarly, five stations were selected for the 34-inch Southern Route, increasing to 10 in 1964. The resulting station spacing could be bisected to add 10 more stations in 1970 to pump up to 550, 000 BPD with a reasonably economical station spacing of about 96 miles. The 30-inch system would not be economical with 32 stations installed. It would appear more economical to loop the pipeline if and when throughput exceeded about 400,000 BPD.

The Northern Route, 115 miles longer, was treated similarly--requiring a nine-station system for the 30-inch, increased to 18 stations in 1963; and a six-station system for the 34-inch increased to 12 in 1964. Station horsepower requirements were calculated for all alternates as described for laterals.

Exhibits 16 and 17 on the following pages show the station discharge pressure and brake horsepower required for each station on the Southern Route alternates for the throughput range under consideration. Both discharge pressure and brake horsepower naturally drop as shown on the Exhibits when intermediate stations are added. Friction loss was based on 3/8" wall pipe.

Station discharge pressures required over the ten-year period were compared with the allowable working pressure of various wall thicknesses of the 30-inch and 34-inch pipe, as previously tabulated. A wall thickness of 13/32" was selected for pipe at station discharge points. This thickness has an allowable working stress by the formula presented of 899 psi and 793 psi for 30-inch and 34-inch pipe respectively.

Stations were located by using large scale profiles of one inch equals four miles horizontally, and one inch equals 400 feet vertically. Hydraulic gradients were drawn to locate stations, assuming 899 psi discharge pressure for stations on the 30-inch system, and 793 psi on the 34-inch system. A suction pressure of 50 psi was allowed at each station and Montreal. All intermediate stations were considered--resulting in a total of 16 stations (including Bellshill Lake) on the 30-inch system, and 20 stations on the 34-inch system.

As discussed, the pressure in the pipeline at any point along the traverse corresponds to the difference in the elevation of the hydraulic gradient and the ground surface at the point in question. This difference in elevation may be called D. After plotting the hydraulic gradients including all future stations, the distance D was carefully examined along the entire traverse. Wherever D converted to psi fell within the allowable working pressure of thinner pipe, the milepost of the point was noted as the start of a different wall thickness. Thus the pipe wall was "telescoped" throughout the entire traverse to provide maximum economy of pipe conducive with projected throughput conditions.

It is interesting to note that in some cases D exceeded the allowable working stress of 13/32" wall pipe due to depressions in ground elevation. Therefore, some 7/16" wall pipe was required. A minimum wall thickness of 5/16" was used for both the 30" and 34" alternates, as lesser walls in these sizes would be subject to excessive damage and defects during construction.

It is reiterated that discharge pressures of future intermediate stations were accounted for in the progressive

selection of wall thicknesses along the traverse. In many sections along the traverse D is greater before intermediate stations are considered than after. This may be easily demonstrated graphically, as the slope of the hydraulic gradient is increased for a given discharge pressure when additional stations are inserted.

A tabulation of wall thicknesses by mileposts is much too detailed for presentation in this report. However, a tabulation of pipe and wall thicknesses by Provinces and States is included in Chapter II under, Analysis of Pipe Requirements. From this tabulation it may be seen that average wall thickness is slightly less than 11/32".

From Exhibits 16 and 17 it is noted that the required discharge pressure in 1969 only, slightly exceeds the allowable working pressure of 13/32" wall pipe. The resulting stress is about 67 percent of yield strength, but heavier pipe was not considered for several reasons. (1) The required throughput is theoretical and may be closely approached with the allowable pressure. (2) A design wall thickness of 3/8" was used while the average actual wall thickness would be less than 11/32", allowing slightly increased flow. (3) The design suction pressure of 50 psi is liberal, and may be partially used to increase flow. (4) The design temperature of 35°F is well below the average flowing temperature anticipated.

PRESSURE-FLOW-HORSEPOWER CURVES
BELLSHILL LAKE-MONTREAL

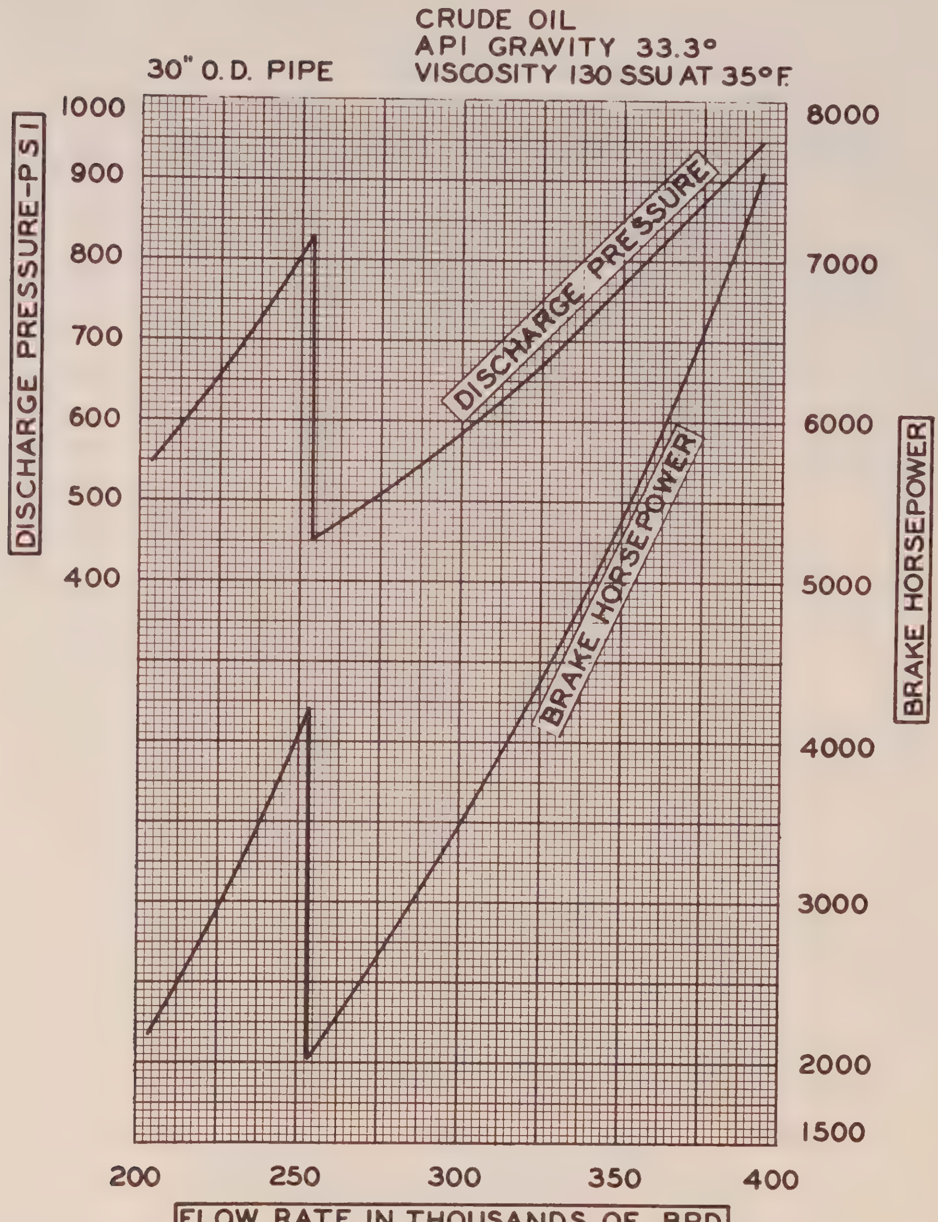



EXHIBIT 16

PRESSURE-FLOW-HORSEPOWER CURVES
BELLSHILL LAKE-MONTREAL

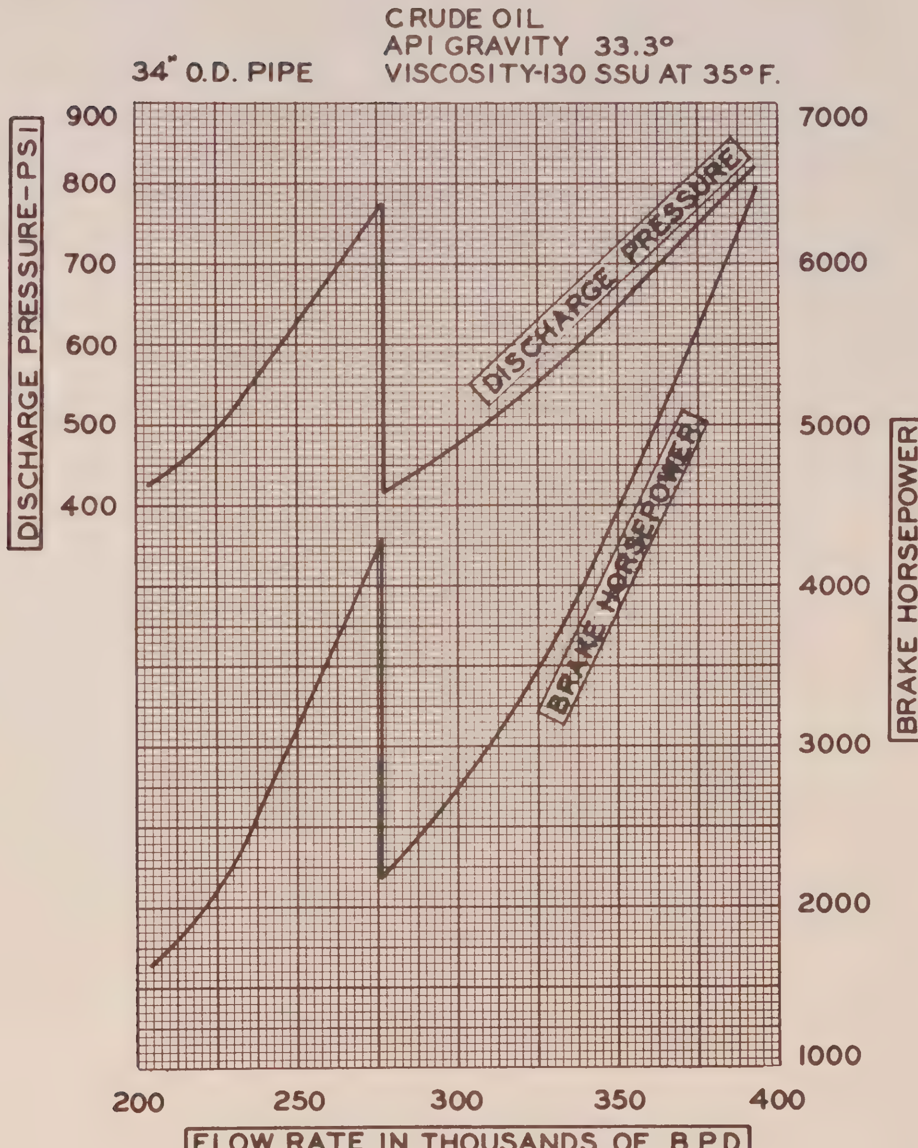



EXHIBIT 17

## E. DESCRIPTION OF PROPOSED FACILITIES

### 1. PIPELINE

The schematic diagram of the pipeline system, Exhibit 2, shows relative locations of all parts of the pipeline system. The table below shows pipe sizes and lengths for the system.

Pipe Sizes and Lengths

| Section | Pipe Size OD, Inches | Pipe Length Miles |
|---|---|---|
| Calgary to Britamoil Junction | 10-3/4 | 73.5 |
| Britamoil Junction to Bellshill Lake | 16 | 71.5 |
| Edmonton to Bellshill Lake | 26 | 100 |
| Bellshill Lake to Montreal South Route | 30 (Alternate) | 1,919 |
| | 34 (Alternate) | 1,919 |
| North Route | 30 (Alternate) | 2,034 |
| | 34 (Alternate) | 2,034 |

The entire pipeline will be coated and wrapped for corrosion protection, and buried to a depth that will allow a minimum of 36 inches of cover in soil, and 20 inches in rock. The coating will consist of a 3/32-inch minimum thickness coat of coal-tar-base enamel preceded by a primer. The pipe will then be wrapped with 15 lb. glass reinforcing wrap, followed by an outer wrap of asbestos felt. Both wraps are recommended for maximum protection of the enamel from damage due to extreme temperature, soil stress, and construction maintenance operation. The Construction Specifications, Volume II, present coating and wrapping procedures. In the event that other materials than specified show economic advantage without sacrificing quality, they may be substituted during final design.

Gate valves will be spaced along the pipeline at approximately 25 mile intervals to serve as safety cutoffs for isolation of sections of the pipeline for repairs of line breaks, maintenance and other contingencies. These gate valves are through-conduit type to allow passage of internal scrapers. For ready accessibility, each gate valve will be located adjacent to a highway. The above ground portion of

each gate valve will be protected by a steel box type shelter with hinged doors for access to the valve operator. Exhibit L shows a typical gate valve installation.

Casings will be installed at all points where the pipeline crosses Provincial or State Highways and railroads. Typical highway and railroad crossing details are shown on Exhibits B and C. The pipeline will be buried under all river and creek crossings as shown on Exhibit D.

The pipeline route will be marked by aerial route markers and ground markers to assist in patrolling the line and to provide reference points by which crews can be directed to pipe breaks or washouts. The pipeline will also be marked at all highway and railroad crossings. Markers are shown on Exhibits F and G.

Additional protection of the pipeline will be provided by the installation of electrolysis test stations as shown on Exhibit E. The tests at these stations will indicate the need for any corrosion protection. Corrosion protection, when needed, would probably consist of buried magnesium anodes. The outer flanges at each station will be insulated to prevent corrosive electrolytic currents.

The Construction Exhibits referred to above and other Construction Exhibits are included as Article 4 of this Section.

## 2. TANKAGE

### a. General

Storage tank installations are planned at four stations. These are Calgary, Britamoil Junction, Edmonton and Bellshill Lake Stations. The tank sizes and capacities for each station are shown in the table below.

Initial Tankage

| Location | Number Required | Capacity, Each | Size |
|---|---|---|---|
| Calgary | 1 | 50,000 bbl. | 86' dia. x 48' |
| Britamoil Jct. | 1 | 30,000 bbl. | 67' dia. x 48' |
| Edmonton | 8 | 100,000 bbl. | 134' dia. x 40' |
| Bellshill Lake | 4 | 150,000 bbl. | 150' dia. x 48' |
| | 2 | 96,000 bbl. | 120' dia. x 48' |
| | 2 | 42,500 bbl. | 80' dia. x 48' |

Tankage to be installed in 1965

| Location | Number Required | Capacity, Each | Size |
|---|---|---|---|
| Edmonton | 3 | 100,000 bbl. | 134' dia. x 40' |
| Bellshill Lake | 2 | 150,000 bbl. | 150' dia. x 48' |
| | 1 | 96,000 bbl. | 120' dia. x 48' |
| | 1 | 42,500 bbl. | 80' dia. x 48' |

All storage tanks will be designed and constructed in accordance with the API Code. Standard storage tank appurtenances will be provided, including ground reading level gauges. Further study should be made to determine the need for tank bottom corrosion protection, tank agitators, tank heaters, remote reading tank level gauges and special exterior paint. Information available at this time indicates that these items will not be needed.

Each tank will be placed on a crowned pad of well compacted fill topped by a layer of oiled sand or asphalt, and will be located in a separate, well drained, firewall enclosure.

b. Storage Tank Capacity Selection Procedure

Calgary Station

The single 50,000 barrel storage tank to be installed at Calgary will be used in conjunction with two existing storage tanks. The 50,000 barrel size was selected as adequate added storage capacity to increase the total tankage to a volume that will allow continuance of existing deliveries to local refineries, and also provide a continuous crude stream for the Calgary Lateral to Britamoil Junction at the design flow rates.

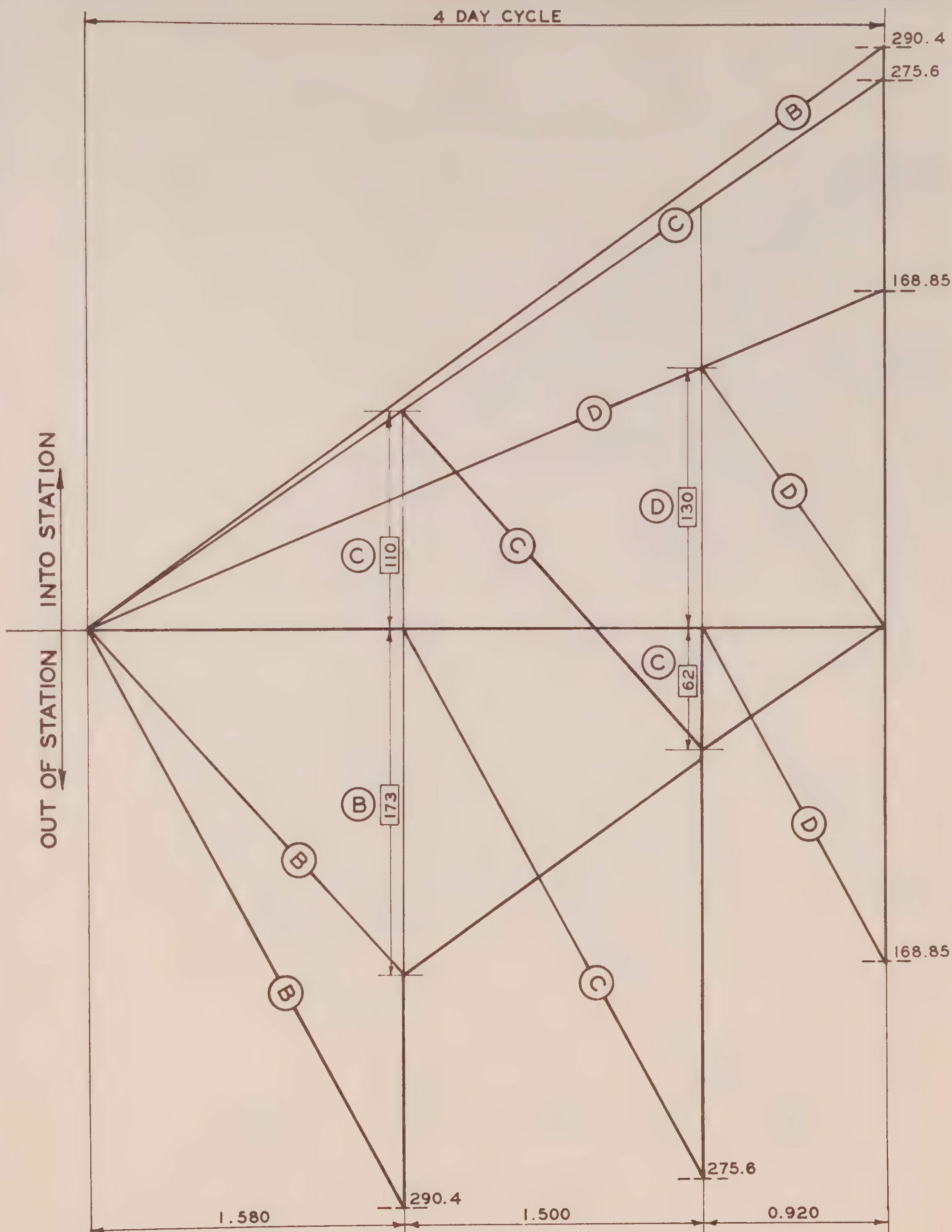
Britamoil Junction Station

The continuous incoming crude streams from Calgary and from the Britamoil line will be comingled in the single 30,000 bbl. storage tank. Station suction will be taken from the same storage tank. The 30,000 bbl. size was judged as adequate to handle this floating operation, allowing for fluctuations in the flow rates of either the incoming streams or the outgoing stream.

Edmonton

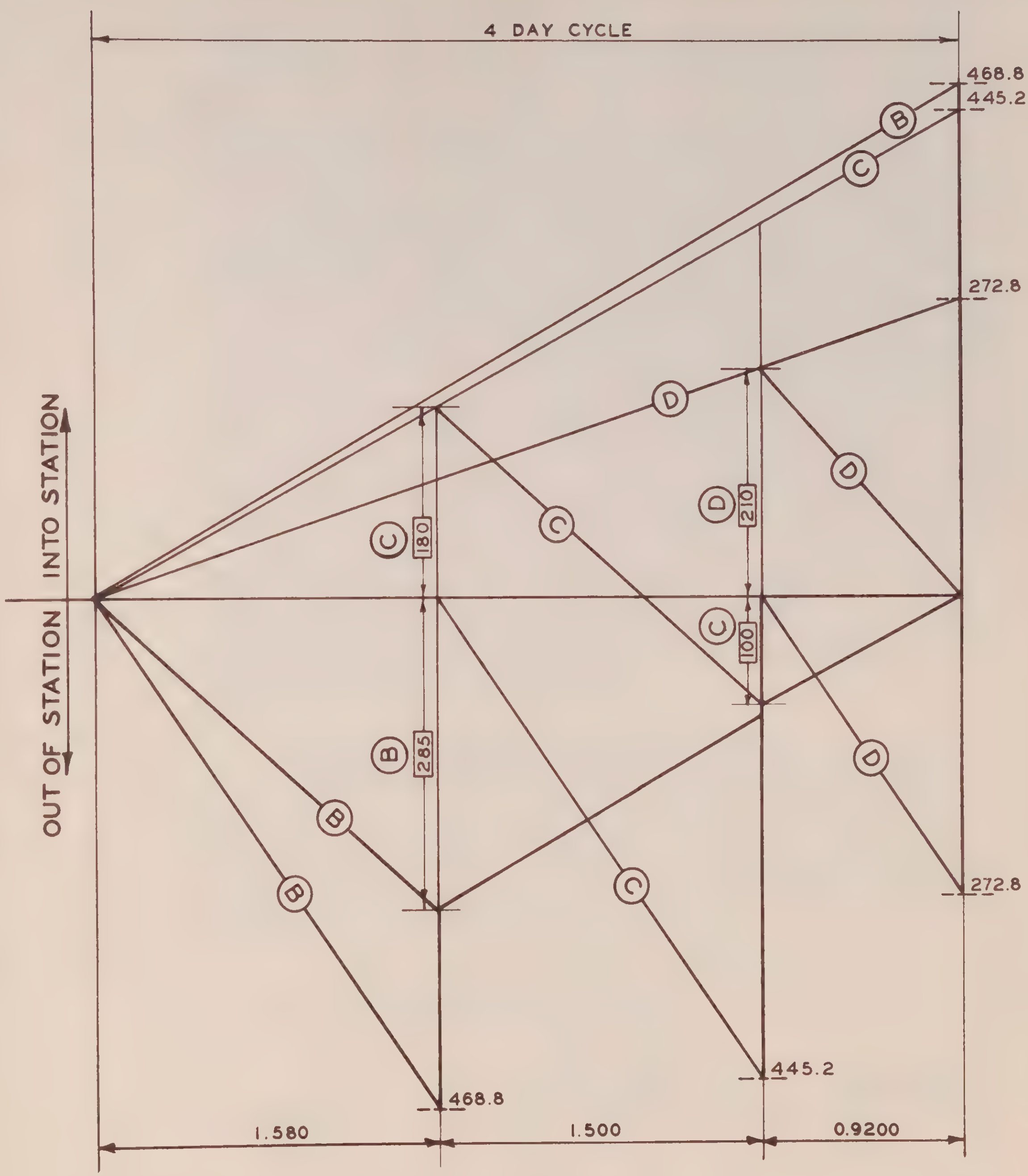
The selection of storage tank capacity at Edmonton is dependent on the scheduling procedure for the system. Three crude streams will each continuously enter the station into tankage. These are the Redwater, Pembina and Alberta Light crudes. The crudes will not be comingled and will require separate tankage. The crudes will be alternately batched from tankage through the line to the Bellshill Lake Station. The tankage must provide ample separate space for each of the three incoming streams, and allow adequate tank volume for crude build up to accommodate the outgoing stream. These two factors were carefully studied in order to reduce the investment cost in tankage to a minimum.

Exhibits 18 and 19 on the following pages show graphically the incoming volumes, the outgoing volumes and the resulting net storage space required to handle the streams at the station. The charts are based on an assumed four day cycle. Each of the three incoming streams will enter the station continuously during the four day cycle. A tender of each crude will be shipped out of the station to Bellshill Lake once during the cycle. The size of the tender will be dependent on the relative incoming rate for the particular crude. For example, the Pembina crude will have the largest incoming volume and as a result the outgoing tender will be the largest.




ALL VOLUMES IN THOUSANDS OF BARRELS
B-PEMBINA CRUDE
C-REDWATER CRUDE
D-ALBERTA LIGHT CRUDE

TANK SCHEDULING CHART
EDMONTON (1962)
EXHIBIT 18




ALL VOLUMES IN THOUSANDS OF BARRELS
B - PEMBINA CRUDE
C - REDWATER CRUDE
D - ALBERTA LIGHT CRUDE

TANK SCHEDULING CHART
EDMONTON (1969)

EXHIBIT 19

Referring to Exhibit 18: crude B (Pembina) is assumed as the first outgoing tender during the cycle, going out of tankage at a rate of 290,400 bbls. per 1.58 day period; crude B is also entering tankage at the rate of 290,400 bbls. per four day period; after 1.58 days of crude B shipment, the stream is switched to crude C (Redwater); during the remainder of the cycle crude B is incoming only and will fill the tanks in preparation for the next shipment; as shown on Exhibit 18 the required minimum tankage for crude B is the net difference in outgoing and incoming volumes at the end of the 1.58 day shipping period, which is 173,000 bbls. Tankage for crude C is analyzed in a similar manner: crude C enters tankage continuously during the four day cycle at the rate of 275,600 bbls. per four days; after 1.58 days have elapsed shipment of crude C begins, at which time 110,000 bbls. have entered the tanks; crude C is shipped at the rate of 275,600 bbls. per 1.50 days after which the outgoing stream is switched to crude D (Alberta Light); as shown on Exhibit 18 the required minimum tankage for crude C is the volume of incoming crude C accumulated at the time shipment began (110,000 bbls.) plus the net difference in volumes of outgoing and incoming crude at the time shipment of crude C ended (62,000 bbls.), making a total of 172,000 bbls. of required storage capacity; after shipment of crude C ends the incoming stream will replenish the tankage. Crude D tankage is evaluated in a similar manner to arrive at a minimum tankage of 130,000 bbls.

The initial tankage requirements are based on Exhibit 18. The volumes shown on Exhibit 18 are those predicated for 1962. However, the tankage selected will be adequate until 1965. In 1965 added tankage will be installed based on Exhibit 19 which shows volumes predicted for 1969. A summary of the theoretical minimum required tankage and the actual tankage selected is presented below.

Total Edmonton Tankage Capacity
(Thousands of Barrels)

| | | Theoretical Minimum | | | Installed | |
|---|---|---|---|---|---|---|
| | Crude | 1962 | 1965 | 1969 | 1960 | 1965 |
| B | Pembina | 173 | 221 | 285 | 300 | 400 |
| C | Redwater | 172 | 219 | 280 | 300 | 400 |
| D | Alberta Light | 130 | 166 | 210 | 200 | 300 |

The installed tankage has been selected to include approximately 50 percent greater volumes than the theoretical minimum volumes to allow for some flexibility in scheduling and to allow for possible variations in incoming and outgoing flow rates.

Bellshill Lake Station

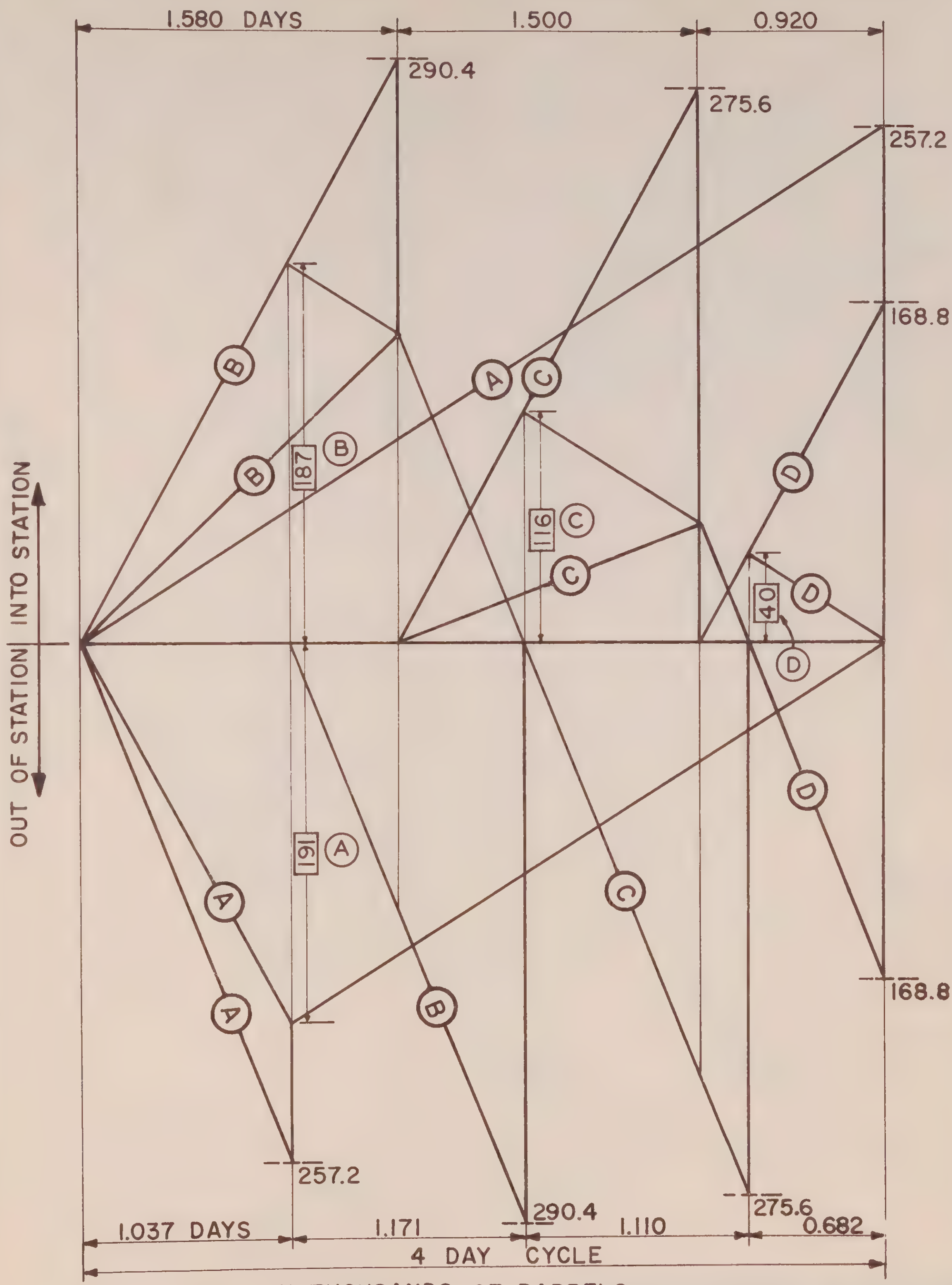
The Bellshill Lake Station has a very similar scheduling situation to that described above for the Edmonton Station. The three crudes from Edmonton will arrive in separate tenders, and will be directed to separate tankage. A fourth set of tanks is required in which the two incoming streams from Britamoil Junction and Bellshill Lake Field will be comingled. These two streams will arrive continuously during the entire four day cycle. The four crudes will each be tendered to Montreal once during the assumed four day cycle.

Exhibits 20 and 21 are charts similar to those described above which show the analysis for determining the theoretical minimum required tankage for each crude. The table below is a summary of theoretical minimum versus installed tankage.

Bellshill Lake Tankage Capacities
(Thousands of Barrels)

| | | Theoretical Minimum | | | Installed | |
|---|---|---|---|---|---|---|
| | Crude | 1962 | 1965 | 1969 | 1960 | 1965 |
| A | Britamoil and Bellshill Lake | 191 | 247 | 273 | 300 | 450 |
| B | Pembina | 187 | 243 | 270 | 300 | 450 |
| C | Redwater | 116 | 150 | 160 | 192 | 288 |
| D | Alberta Light | 40 | 60 | 70 | 85 | 127.5 |

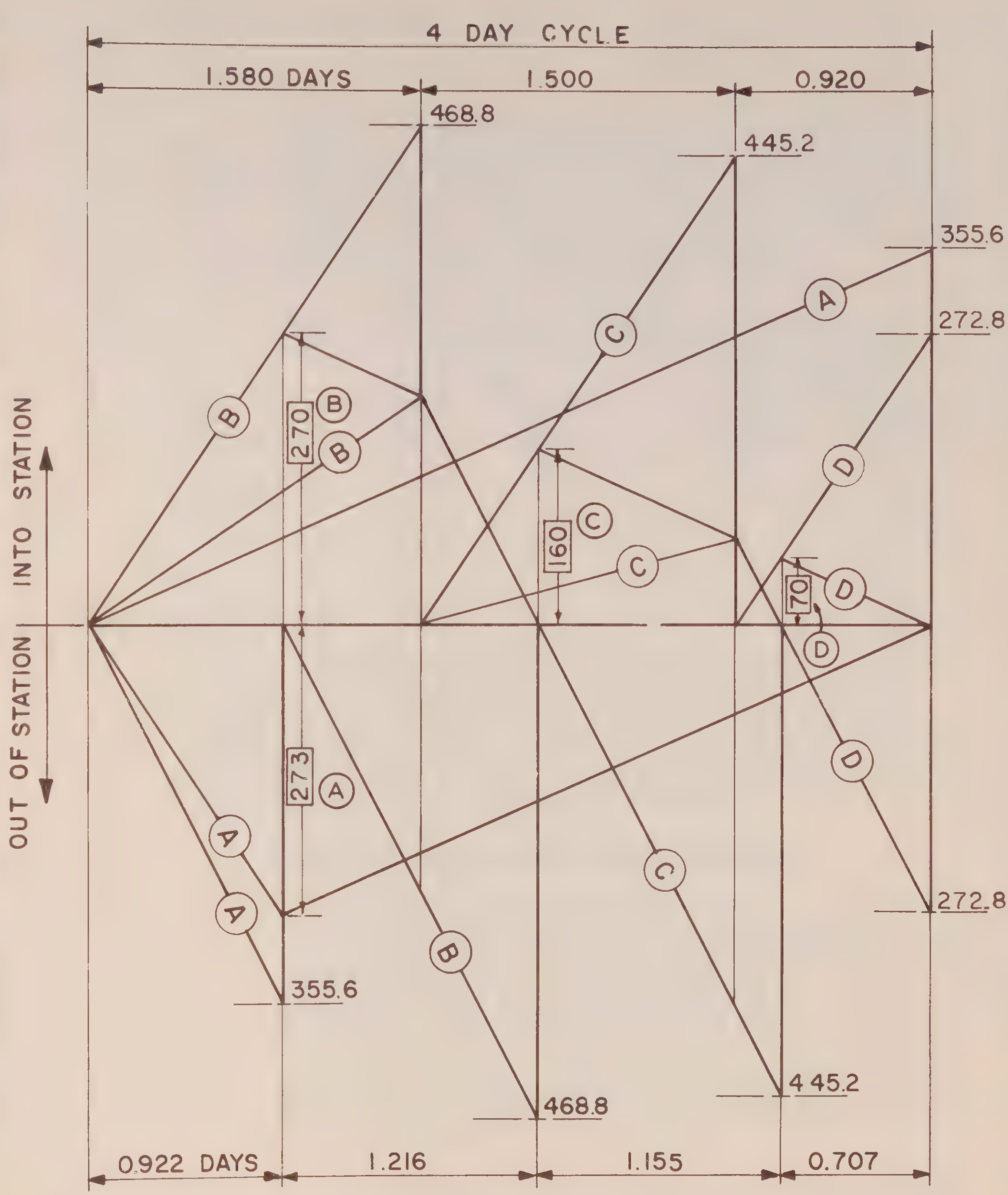
Here, as at Edmonton, the installed tankage will be approximately 50 percent greater than the theoretical minimum, in order to provide continuous, flexible operation.




ALL VOLUMES IN THOUSANDS OF BARRELS

A - CALGARY & BELLSHILL LAKE CRUDE
B - PEMBINA CRUDE
C - REDWATER CRUDE
D - ALBERTA LIGHT CRUDE

TANK SCHEDULING CHART
BELLSHILL LAKE (1962)
EXHIBIT 20




ALL VOLUMES IN THOUSANDS OF BARRELS

A - CALGARY & BELLSHILL LAKE CRUDE
B - PEMBINA CRUDE
C - REDWATER CRUDE
D - ALBERTA LIGHT CRUDE

TANK SCHEDULING CHART
BELLSHILL LAKE (1969)
EXHIBIT 21

## 3. STATIONS AND TERMINAL

### a. General

As shown on the Route Map, Exhibit 1, all alternate systems will include pumping stations at Calgary, Britamoil Junction, Edmonton and Bellshill Lake with a terminal at Montreal. The number of intermediate Main Line stations will vary with Main Line size and route. The table below shows the number of intermediate Main Line stations for each alternate.

Number of Intermediate Main Line Pumping Stations

| Year Installed | 30" Line Southern Route | 30" Line Northern Route | 34" Line Southern Route | 34" Line Northern Route |
|---|---|---|---|---|
| 1960 | 7 | 8 | 4 | 5 |
| 1963 | 15 | 17 | -- | -- |
| 1964 | -- | -- | 9 | 11 |

All stations will be similar in many respects. The facilities that are typical for all stations will be described in the paragraphs below. The particular arrangement of each station will be described in subsequent paragraphs. Exhibits 23 through 30 show schematic arrangements for each station, indicating the main facilities to be installed.

Office Building (Refer to Exhibits 29 and 30)

An office building will be erected at each station and at the terminal, which will include: main office and control area; garage, storage and workshop area; locker room; switchgear and motor control center room; and boiler room. The building will be of double wall construction with concrete block on the inside and face brick on the exterior. The floor will be concrete slab, covered with composition tile, and the ceiling will include acoustical tile and insulation.

The office and control area will include space for the control console, control and recording instruments, communications equipment and office furniture. The garage will include space for storage, and provisions for repair work on instruments and equipment. The switchgear room will house the switchgear, motor control centers and relay cabinets.

The locker room will include lockers, water closet, wash basin and shower facilities for the personnel attached to the station. The boiler room will include a boiler for office building heating, instrument air compressor, air tank, air dehydrator, water pump, water softener, water system pressure tank and hot water heater. Steam heat will be provided throughout the building. Ample building lighting and electrical outlets will be provided.

## Pump House (Refer to Exhibit 30)

A separate pump house will be erected at all stations except at Calgary and at the Montreal terminal. The pump house, which primarily houses the main pump units, will be of all metal construction and fully insulated. The floor will be concrete slab, surfaced with Masterplate. All pump houses containing diesel engine units will require a concrete block firewall between pumps and engines.

The pump house will also house the diesel-electric generator units for station power in cases where local power is not available. Other equipment located in the pump house will include the air compressor and air storage tanks for engine starting air, fuel oil day tanks, centrifuges and an explosive gas mixture warning system for the pump area. An interconnecting passageway will join pump house and office building for use during inclement weather.

## Main Pump Units

Diesel engines with centrifugal pumps connected through a speed increaser have been tentatively selected as the main pumping units for all stations, as it is assumed that low cost electric power will not be available at the majority of the locations. Further detailed investigation may show that electric motor driven units will be feasible at some locations. The engines preliminarily selected are dual-fuel engines able to use diesel fuel, natural gas and some grades of crude oil. The use of crude oil will reduce the fuel cost. However, the use of some crudes may result in added maintenance cost offsetting the savings in fuel.

As shown on the exhibits, all main pump units are connected in series. Detailed investigation may indicate that the future units should be added in parallel to the

initial units. It may also prove feasible to add the future units to the downstream side of the initial units instead of to the upstream side as shown on the exhibits. Considerable detailed study must be made before final pump unit selection.

Station Piping

All station piping, fittings and valves at the pump manifolds and downstream of the pump units will be designed for ASA 600 lb. pressure rating. Tank piping, tank manifold piping, strainer piping and other piping upstream of the main pumps will be designed for ASA 150 lb. pressure rating where possible. The above ground pipe will be painted. The buried pipe will be coated and wrapped.

Ample supports and anchors for above ground piping will be installed. Platforms and catwalks for access to valves will be provided. Dual basket type strainers are included in the station manifold line upstream of the main pumps. Each strainer will handle full flow and will be operated alternately, allowing cleaning during the off cycle.

Scraper Traps

Scraper traps will be installed at each station to permit cleaning the main line by pigging. Each scraper trap will include a quick disconnect cover for fast pig removal and a bypass line to be used when launching or receiving the pig.

Meters

Meters will be installed at Calgary, Britamoil Junction, Bellshill Lake and Montreal. The sheltered metering installations will include P. D. type meters, strainers, prover tank, sump and pump to service prover tank and sump. The meters will be equipped with counters and ticket printers. Equipment supports and access platforms will be installed.

Electrical

It is assumed that local electrical power for miscellaneous station needs will be available at Calgary, Britamoil Junction, Edmonton, Bellshill Lake and Montreal. It is also assumed that local power will not be

available at the intermediate stations. The intermediate stations will each require the installation of one 60 KW diesel-electric generator set and one 40 KW set as a standby.

These units will supply electric power for miscellaneous station needs including building lighting, communications, controls, small motors, shop equipment and personnel quarters. Switch-gear for the generators will be located in the office building. Yard lights will be provided at all operating areas. All facilities will be grounded.

Instrumentation and Controls

A summary of the instrumentation and controls is presented below. This applies to all stations unless otherwise noted. The center of the control system will be the control console located in the office.

(a) The control console will include the following:

(1) Schematic of station with switches and operation indication lights for booster pump and motor operated valves (no booster pump at intermediate stations). Operation indication lights only for main pump units and radiator operation.

(2) Automatic controllers and recorders for station discharge pressure, station suction pressure, and station flow. Recorders actuated by changes in air pressure from pressure cells located on manifold.

(3) Warning by lights and by buzzer and horn of:

High station discharge pressure
Low station suction pressure
Station flow not within desired range
High engine speed
High pump bearing temperature
High pump case temperature
Pump seal failure
High sump level
Instrument air failure

(4) Emergency shutdown switch for pump units.

(5) Automatic pump unit shutdown in event of:

High station discharge pressure
Low station suction pressure
High engine speed
High engine jacket water temperature
Low engine lube oil pressure
High pump bearing temperature
High pump case temperature
Pump seal failure

(6) Automatic equipment for engine control during warm up period.

(b) The engines will be started at the instrument panel mounted on their respective engine unit. The engine instrument panels will also include the following:

(1) Visual indication of:

Engine speed
Engine jacket water temperature
Engine jacket water pressure
Engine lube oil temperature
Engine lube oil pressure
Engine fuel oil pressure
Engine exhaust temperature

(2) Warning by lights and by buzzer or horn of:

High engine jacket water temperature
Low engine lube oil pressure

(c) Other controls and instrumentation provided in the station include:

(1) Recording thermometer for outgoing crude.
(2) Direct reading pressure gauges at manifold, strainers, booster pump, scraper trap.
(3) Station shutdown switch outside building.
(4) Mercoid switches for shutdown for pump bearing temperature and pump case temperature will be located on small rack immediately adjacent to each pump.
(5) Outgoing gravity measurement.

## Communications

It is assumed that all voice and teletype communications will be by leased wire.

## Fuel System

A 1,000 bbl. fuel tank will be provided at each station (except Calgary and Montreal) to store either diesel oil or crude oil for engine fuel. It is assumed the crudes transported will prove satisfactory for engine use. The crude may be taken from the Main Line into the fuel tank. The tank will be a cone roof type, enclosed by a firewall and will be equipped with steam coils to heat the fuel. Piping will be provided from the fuel tank to a 30 bbl. fuel day tank in the pump house.

Centrifuges will be required to purify the crude oil when used as fuel. The crude will pass through the centrifuge before entering the day tanks. As crude oil may be used as fuel, it is advisable to install a separate 30 bbl. diesel fuel day tank for emergency use and to use when running down the engines in order to maintain clean nozzles.

## Drain System

Each station will require an oil drain system to receive crude oil drainage from station piping and equipment. This will include a sump tank with lines from scraper traps, pumps and manifold piping. A rotary vane type pump will be installed to pump out the sump tank to the suction side of the station.

The large metering installations will have separate sump tanks and pumps. The sump tanks will be equipped with a three position control switch which will automatically start the sump pump when the sump is full, and will stop the sump pump when a low level is reached. The third and highest position will cause an alarm when the sump is near overflow.

## Water System

It is assumed that water will be available at all locations from wells or streams. A water pump, pressure tank and water softener will be installed for station needs. The engines will be water cooled which requires the installation of fan cooled radiator units for each engine. Precautions will be taken to prevent

freezing of the water lines.

Sewage System

The sewage system at each station will include a septic tank with an adequate drain field.

Fire Fighting Equipment

Portable, foam type, fire fighting equipment will be installed in the office building, pump house and will be strategically located in the operating areas.

Yard Improvements

All station sites will be graded to assure proper drainage and good appearance. Sidewalks will be provided between work areas, and needed area roads will be built. Station areas will be fenced.

Staff Housing

It is assumed that staff housing will be required at all stations with the exception of Calgary, Edmonton, Montreal, and two other stations. Adequate housing was estimated to consist of four houses and a dormitory.

b. Calgary Station (Refer to Exhibit 23)

The initial installation at the Calgary Station will include a 50,000 bbl. storage tank, 20 HP electric drive booster pump, sheltered metering area with two three-inch meters, office building and outgoing scraper trap.

The new storage tank will be manifolded with the two existing storage tanks to receive crude from the field and provide crude to the pipeline. Initially the 20 HP booster pump will furnish enough total pumping capacity for the station. The crude will be metered, as tank gauging does not appear to be feasible for custody transfer since crude from the tankage will be delivered to local refineries simultaneously with deliveries to the pipeline.

Future expansion will include a pump house and a 150 HP centrifugal pump unit in 1963. A second 150 HP pumping unit and a third three-inch meter will be added in 1965.

c. Britamoil Junction Station (Refer to Exhibit 24)

Initially at Britamoil Junction the facilities will include an incoming scraper trap, sheltered metering installations for each of the incoming streams, a 30,000 bbl. storage tank, 75 HP booster pump, two 600 HP engine driven centrifugal pump units, office building, pump house and outgoing scraper trap.

The metering installation will include three six-inch meters for the incoming stream from the Britamoil line, and two three-inch meters for the incoming line from Calgary. Both streams will be comingled in the storage tank and drawn out as one main stream to Bellshill Lake. The tank will be floating on the line and gauging will not be feasible for custody transfer. The 75 HP booster pump will supply 50 psi suction pressure to the main pumps.

Future additions will include a 25 HP booster pump in 1963, a third 600 HP main pump unit in 1964, and a third three-inch meter in 1965.

d. Edmonton Station (Refer to Exhibit 25)

The Edmonton Station will initially include eight 100,000 bbl. storage tanks, three 75 HP tank booster pumps, one 250 HP main booster pump, dual strainers, two 1,000 HP engine driven centrifugal pump units, pump house, office building and outgoing scraper trap.

The three incoming streams will be handled in separate tankage. Each crude in its turn will be tendered from tankage through the Main Line to Bellshill Lake. The tank valves, tank manifold valves and pump manifold valves will all be motor operated and controlled from the office to enable quick and convenient tank switching and pump startup.

Future expansion will include: the addition of a 100 HP main booster pump and a 2,000 HP main pump unit in 1962; a pump house extension, one 2,000 HP main pump unit and three 100,000 bbl. storage tanks in 1965; and a 2,000 HP pump unit in 1967. Metering of the incoming stream may be desirable in the future. Initially the storage tanks will be gauged for custody transfer. Consideration should be given to the need for sampling and BS and W monitoring facilities.

e. <u>Bellshill Lake Station (Refer to Exhibit 26)</u>

The Bellshill Lake Station will include incoming scraper traps for the lines from Britamoil Junction and Edmonton, sheltered metering areas for each of three incoming lines, four 150,000 bbl. storage tanks, two 96,000 bbl. tanks, two 42,500 bbl. tanks, four 100 HP tank booster pumps, one 250 HP main booster pump, dual strainers, office building, pump house, two 2,000 HP engine driven centrifugal pump units and an outgoing scraper trap.

The three incoming streams will be from Edmonton, Britamoil Junction and Bellshill Lake Field. The Edmonton stream will include three batched crudes. The streams from Britamoil Junction and Bellshill Lake Field will be comingled at the station. This means that four crudes must be handled separately in the station. The Edmonton stream will be metered with four 10-inch meters, the Britamoil Junction stream with three 6-inch meters and the Bellshill Lake Field stream with two 3-inch meters.

Each crude will be directed to a separate group of tanks through an incoming manifold. The four crudes will be alternately tendered out of tankage in cycles through the outgoing manifold into the Main Line to Montreal. The tank valves, incoming manifold valves, outgoing manifold valves and the pump manifold valves will all be motor operated with control from the office.

Future expansion will require: one 100 HP booster pump in 1963; two 100,000 bbl. tanks, one 96,000 bbl. tank, one 42,500 bbl. tank and one 2,000 HP main pump unit (30-inch line only) in 1965; one 2,000 HP pump unit (34-inch line only) in 1966; and one 2,000 HP pump unit and pump building extension in 1968 (30-inch line only).

f. <u>Typical Intermediate Station (Refer to Exhibit 27)</u>

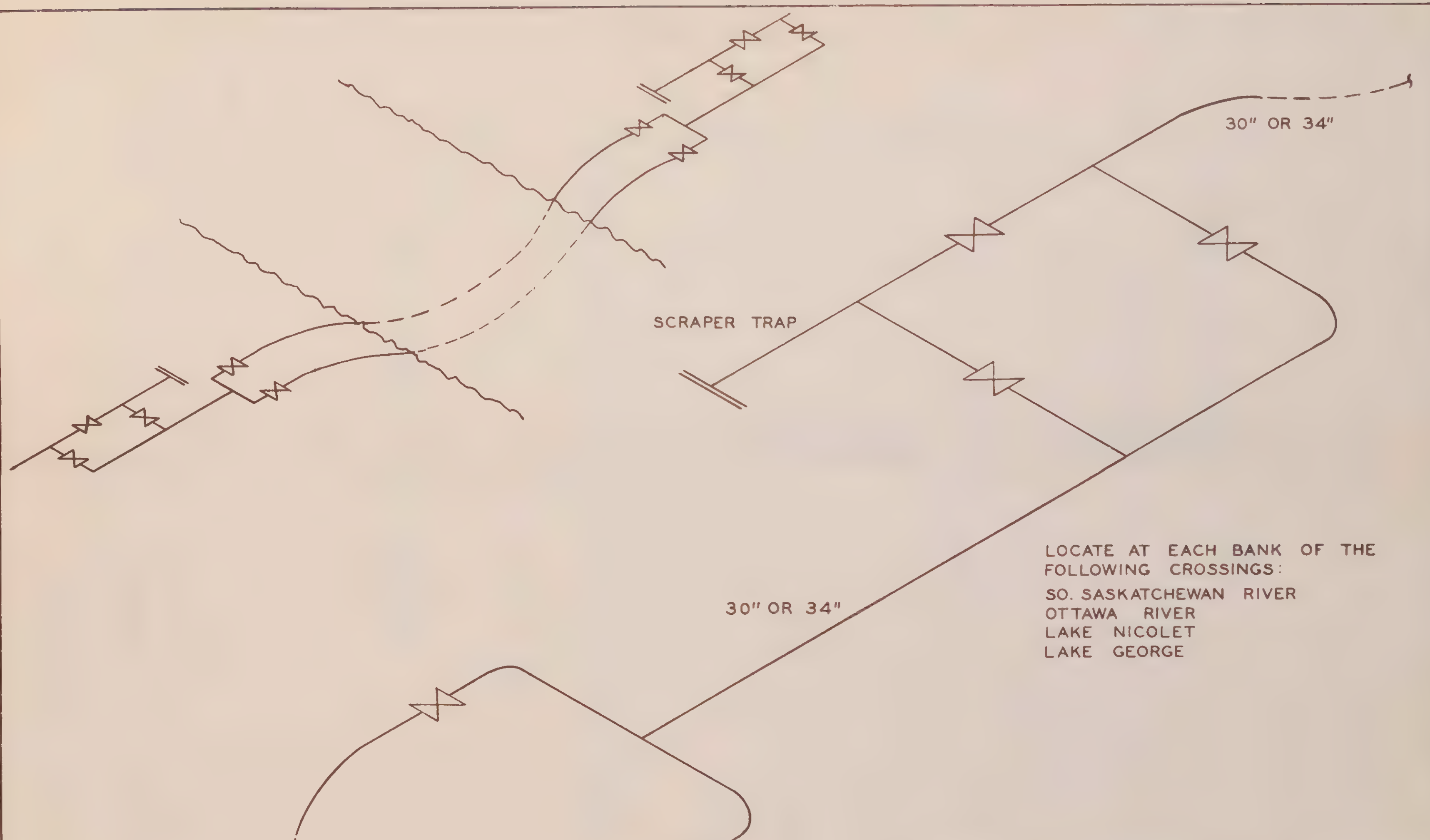
The initially installed facilities will include incoming scraper trap, dual strainers, two 2,000 HP engine driven main pump units, pump building, office building, outgoing scraper trap and personnel housing. A bypass line will be provided to allow bypass of a shutdown station. Pump manifold valves will be motor operated with control from the office.

Future added facilities will include: one 2,000 HP pump unit in 1965 (30-inch line only); one 2,000 HP pump

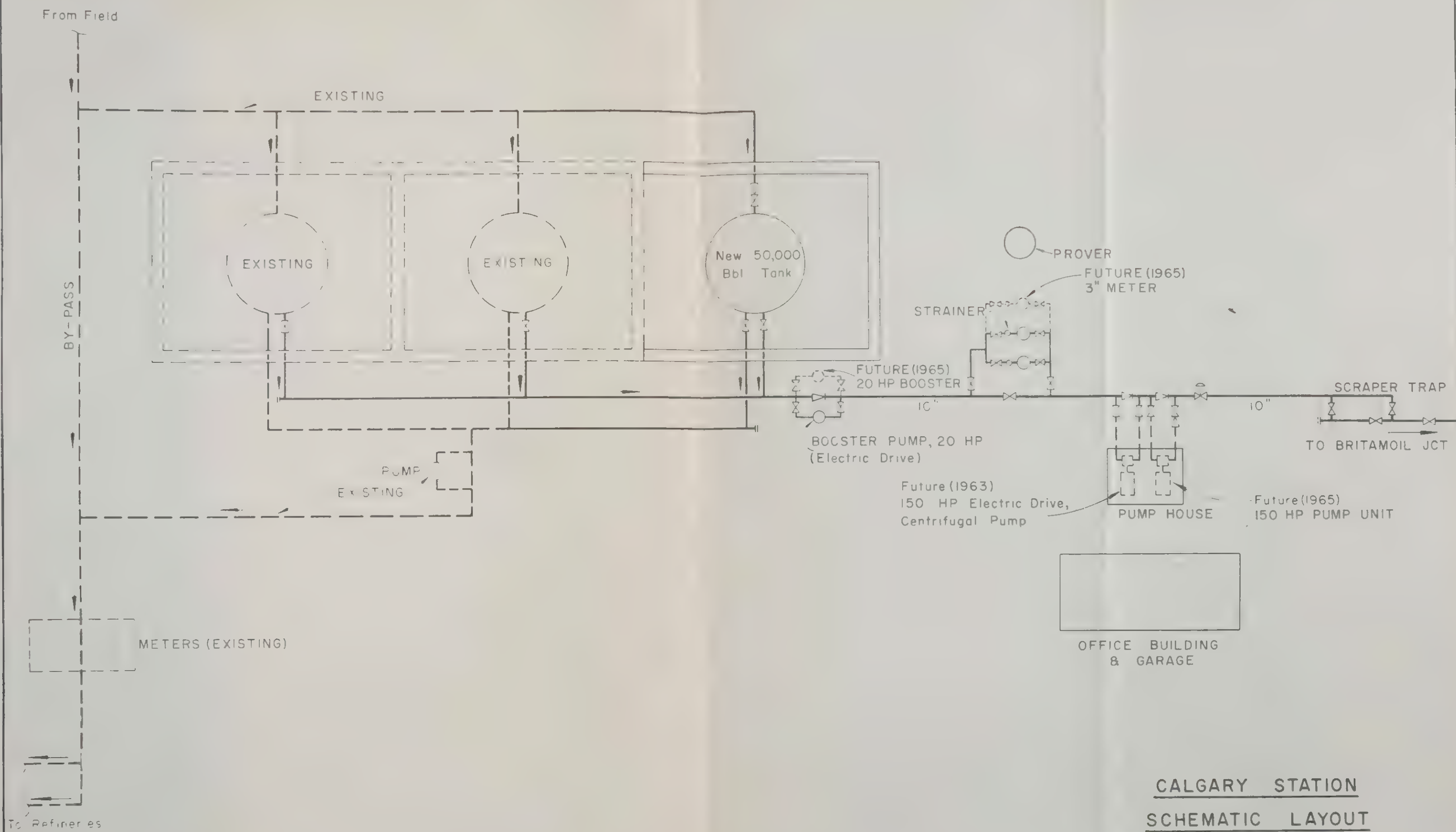
unit in 1966 (34-inch line only); one 2,000 HP pump unit in 1968 (30-inch line only).

g. Montreal Terminal (Refer to Exhibit 28)

The Montreal terminal will include an incoming scraper trap, sheltered metering installation with four 10-inch meters, office building and a delivery header. Deliveries will be made to refineries in the Montreal area. The valves on the delivery manifold will be motor operated and controlled from the office. Pipeline ownership will include the delivery manifold valves. Future additions will include one 10-inch meter in 1963 and one 10-inch meter in 1965.



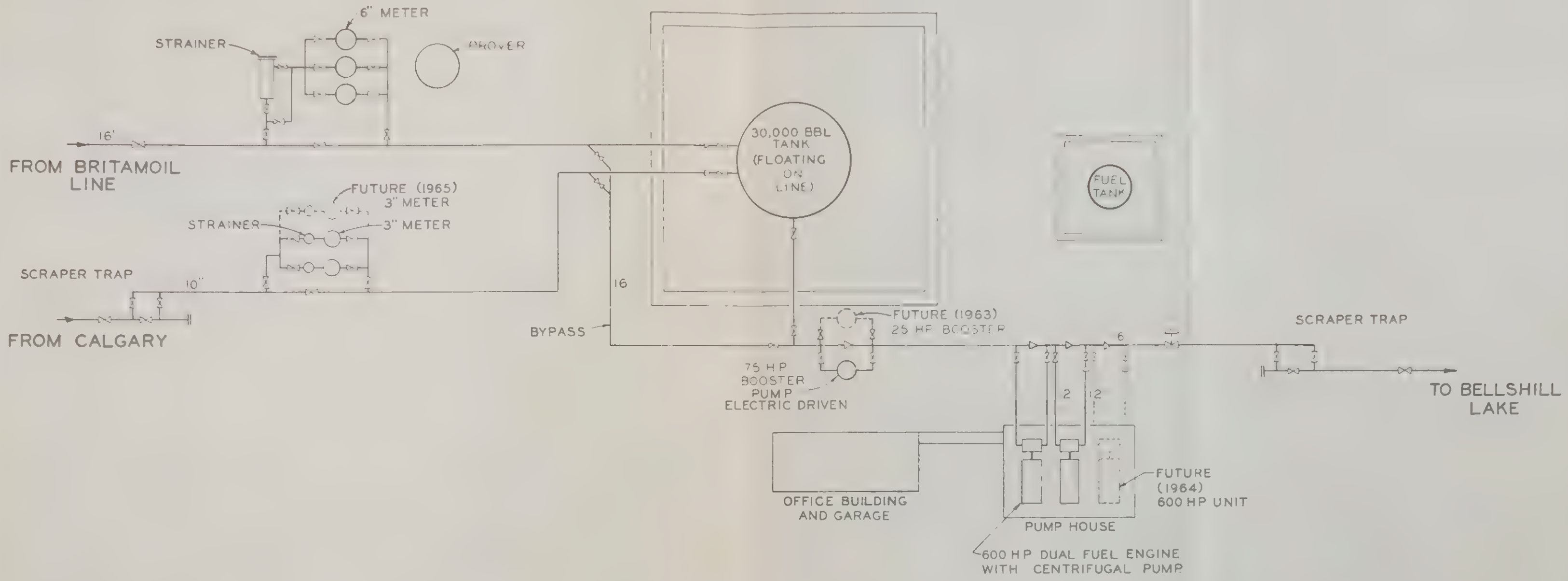

TYPICAL MANIFOLD & SCRAPER TRAP AT WATER CROSSINGS
SCHEMATIC LAYOUT
EXHIBIT 22



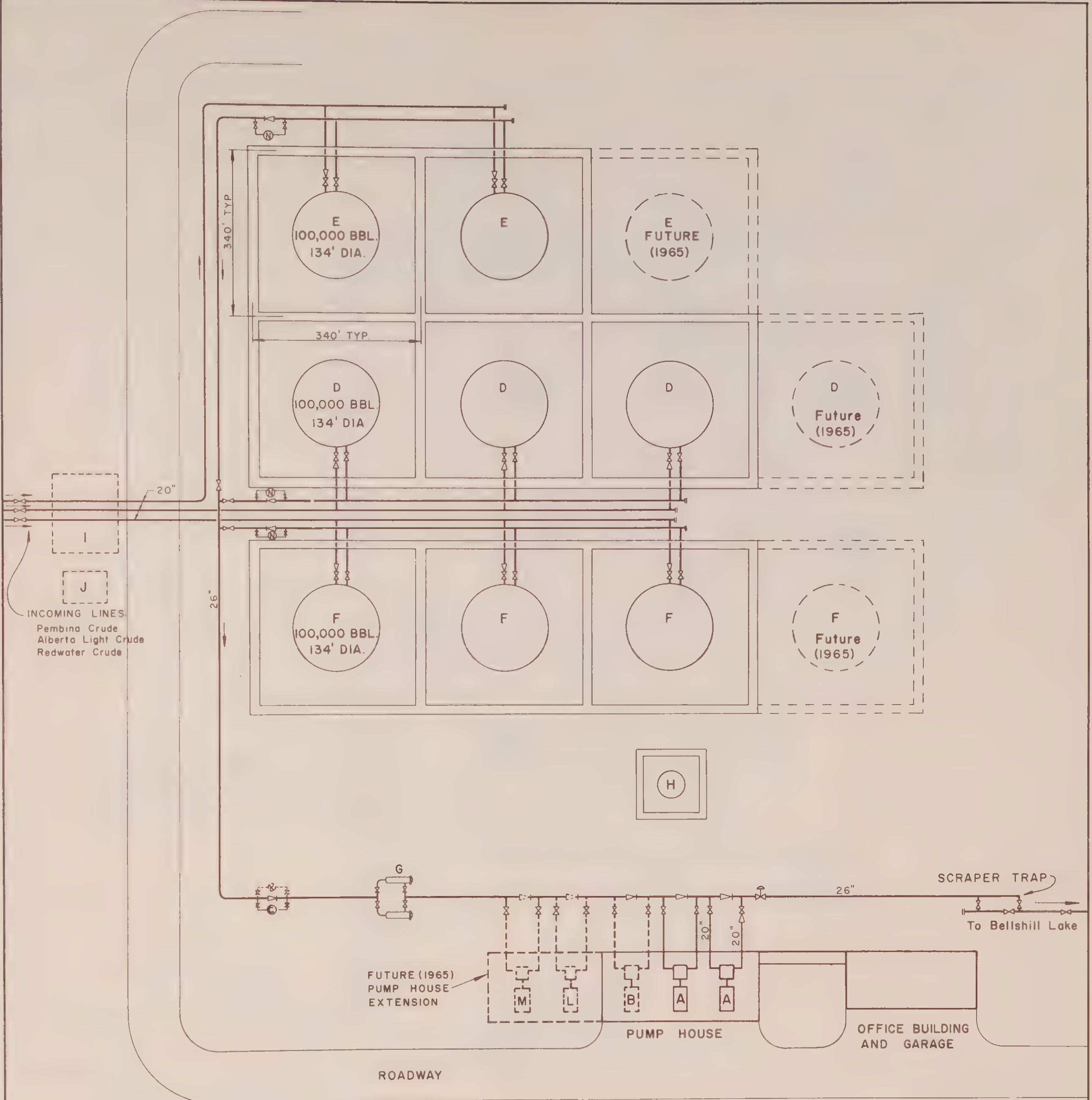

CALGARY STATION

SCHEMATIC LAYOUT

EXHIBIT 23



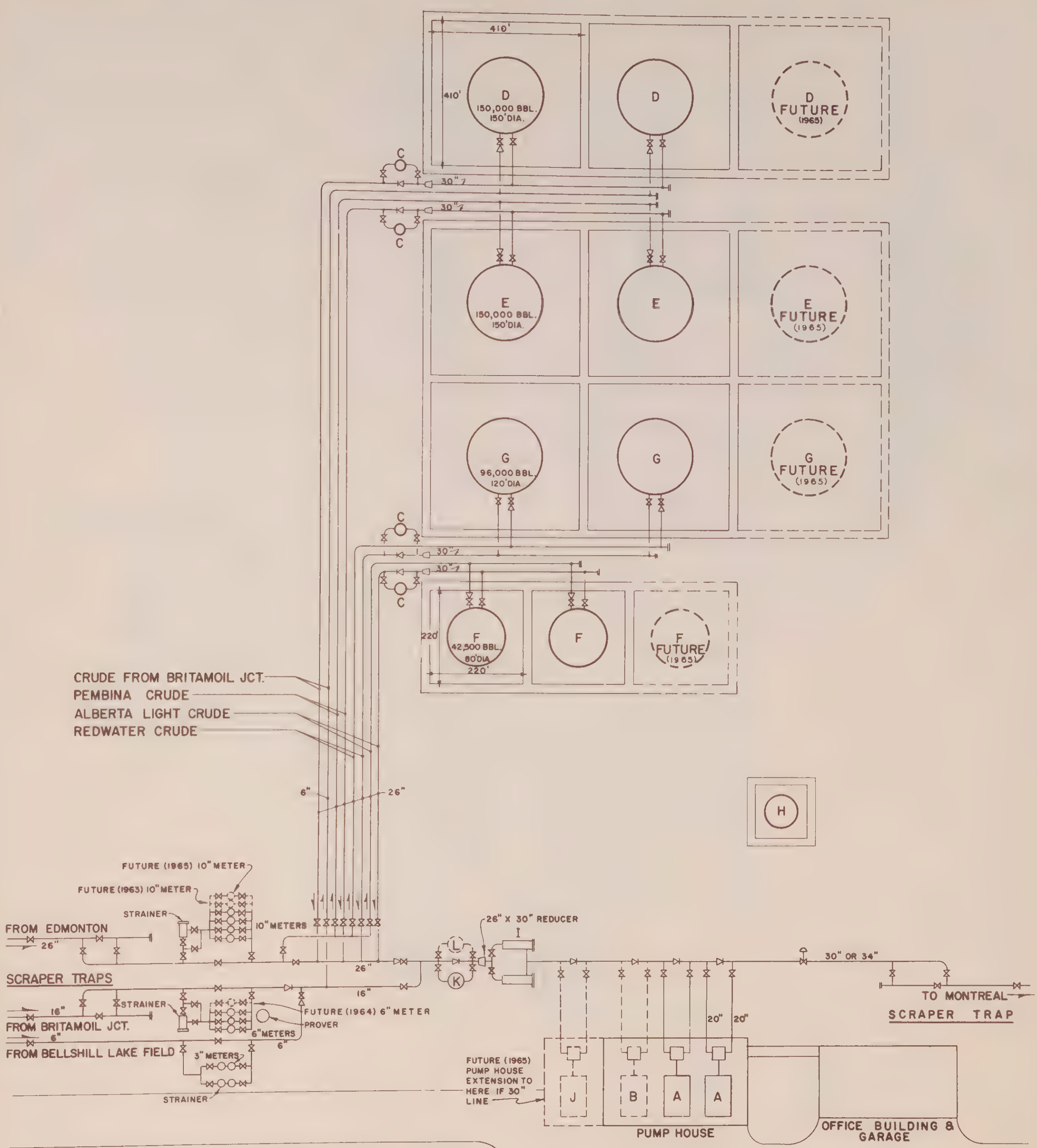

BRITAMOIL JCT. STATION
SCHEMATIC DIAGRAM
EXHIBIT 24




A – 1000 HP Dual-Fuel Engine With Centrifugal Pump
B – Future (1962) 2000 HP Dual-Fuel Engine With Centrifugal Pump
C – 250 HP Booster Pump, Electric Drive
D – Storage Tanks — Pembina Crude; 100,000 Bbl; 134' x 40'
E – Storage Tanks — Alberta Light Crude; 100,000 Bbl; 134' x 40'
F – Storage Tanks — Redwater Crude; 100,000 Bbl; 134' x 40'
G – Dual Strainers
H – Fuel Tank
I – Future Metering Area
J – Future Sampling And Testing Building
K – Future (1962) 100 HP Booster Pump
L – Future (1965) 2000 HP Pump Unit
M – Future (1967) 2000 HP Pump Unit
N – 75 HP Booster Pump, Electric Drive

EDMONTON STATION
SCHEMATIC LAYOUT

EXHIBIT 25

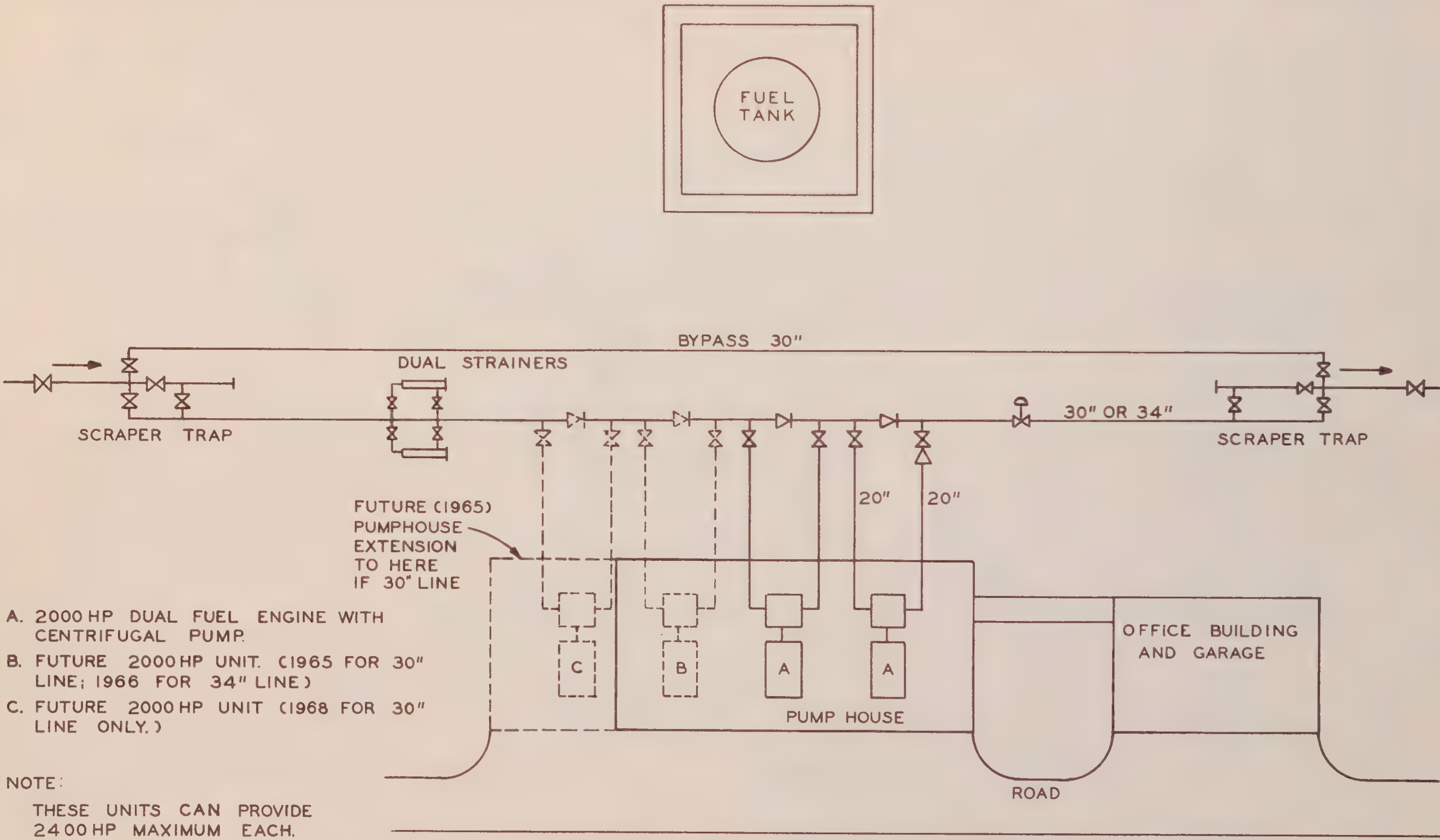



*A - 2000 H.P. DUAL FUEL ENGINE WITH CENTRIFUGAL PUMP
*B - FUTURE 2000 H.P. UNIT (1965 FOR 30" LINE; 1966 FOR 34" LINE)
C - 100 H.P. BOOSTER PUMP, ELECTRIC DRIVE
D - STORAGE TANKS - CRUDE FROM BRITAMOIL JCT. & BELLSHILL LAKE FIELD; 150,000 BBL.; 150' x 48'
E - STORAGE TANKS - PEMBINA CRUDE; 150,000 BBL.; 150' x 48'
F - STORAGE TANKS - ALBERTA LIGHT CRUDE; 42,500 BBL.; 80' x 48'
G - STORAGE TANKS - REDWATER CRUDE; 96,000 BBL.; 120' x 48'
H - FUEL TANK
I - DUAL STRAINERS
*J - FUTURE 2000 H.P. UNIT (1968 FOR 30" LINE ONLY)
K - 250 H.P. BOOSTER PUMP ELECTRIC DRIVE
L - FUTURE (1963) 100 H.P. BOOSTER PUMP

* NOTE - THESE UNITS CAN PROVIDE 2400 H.P. MAX. EACH

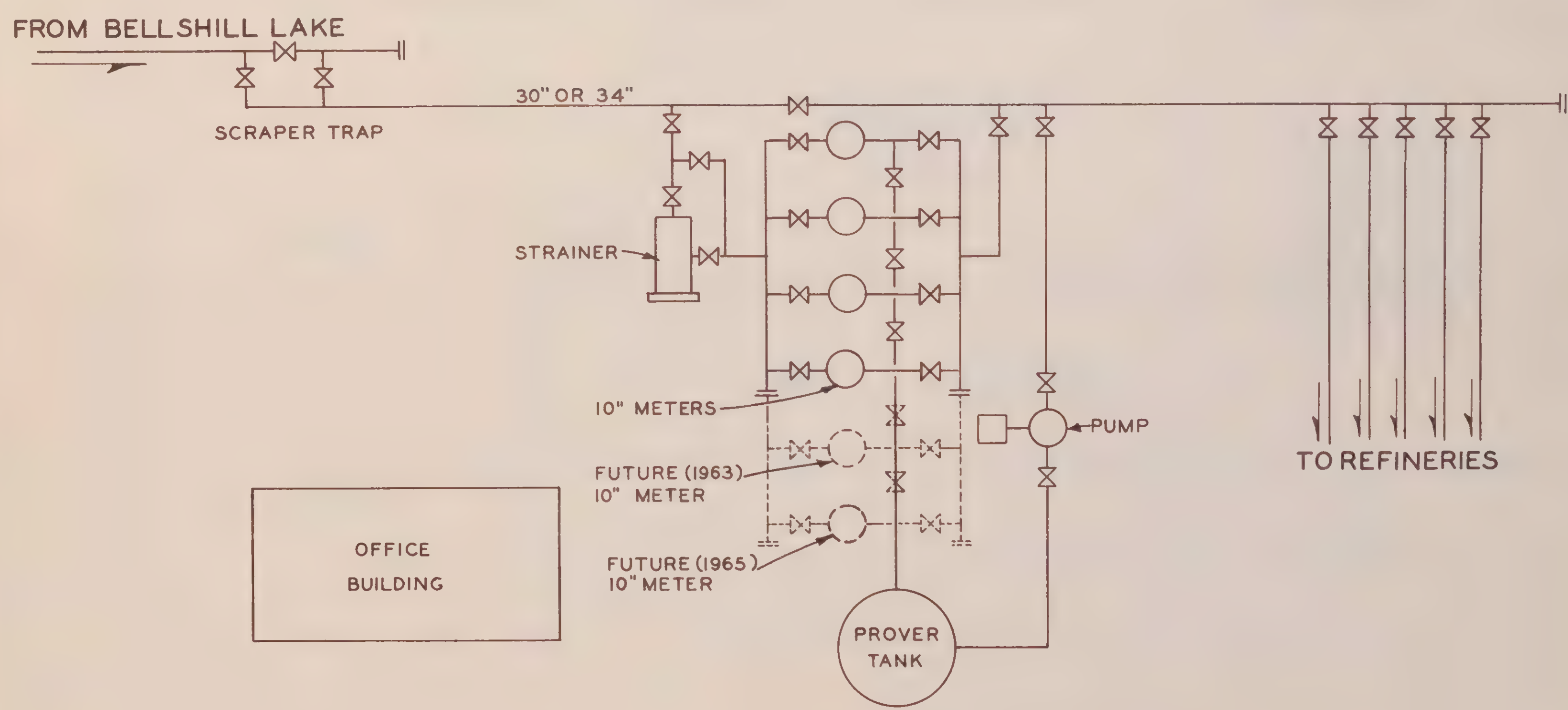
BELLSHILL LAKE STATION
SCHEMATIC LAYOUT
EXHIBIT 26

TMC




TYPICAL INTERMEDIATE STATION
SCHEMATIC LAYOUT

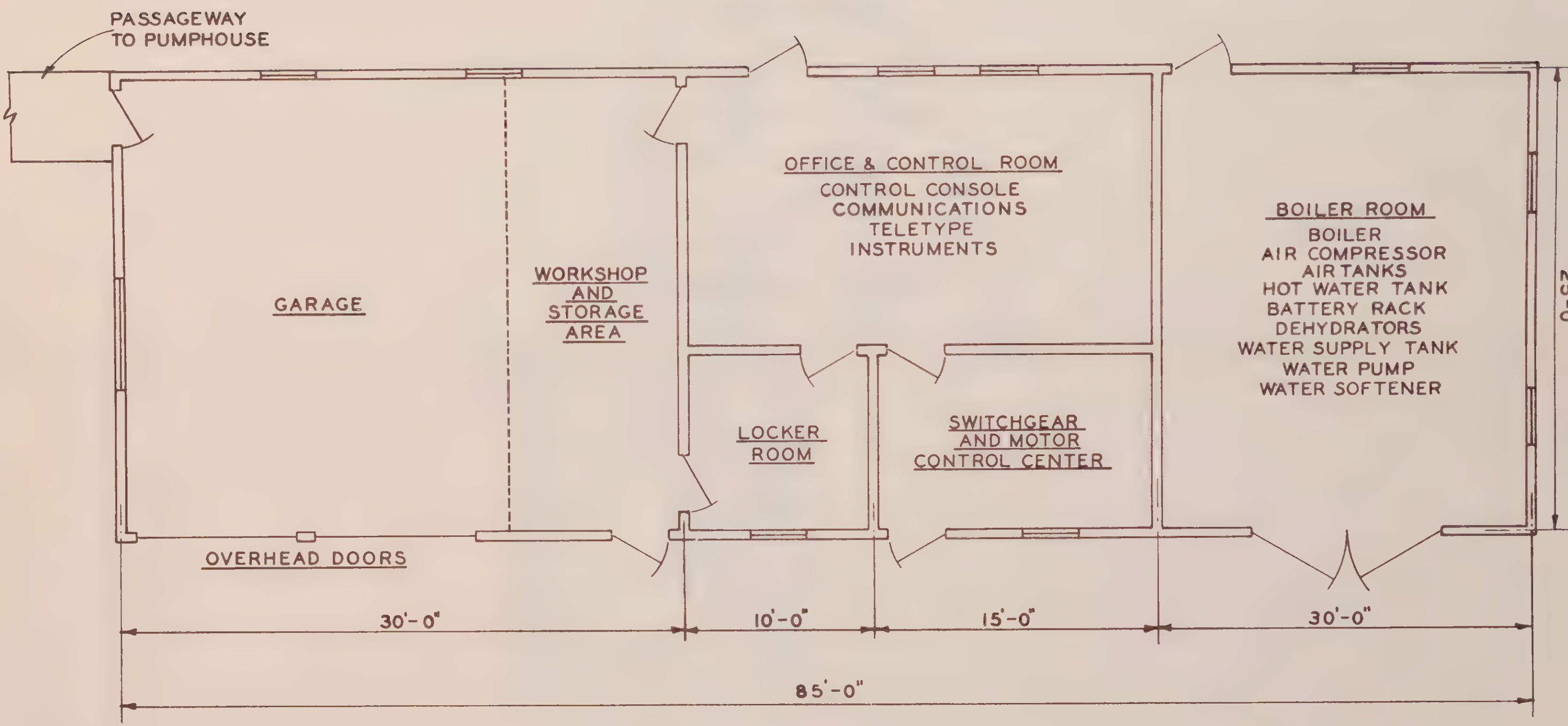
EXHIBIT 27




MONTREAL TERMINAL

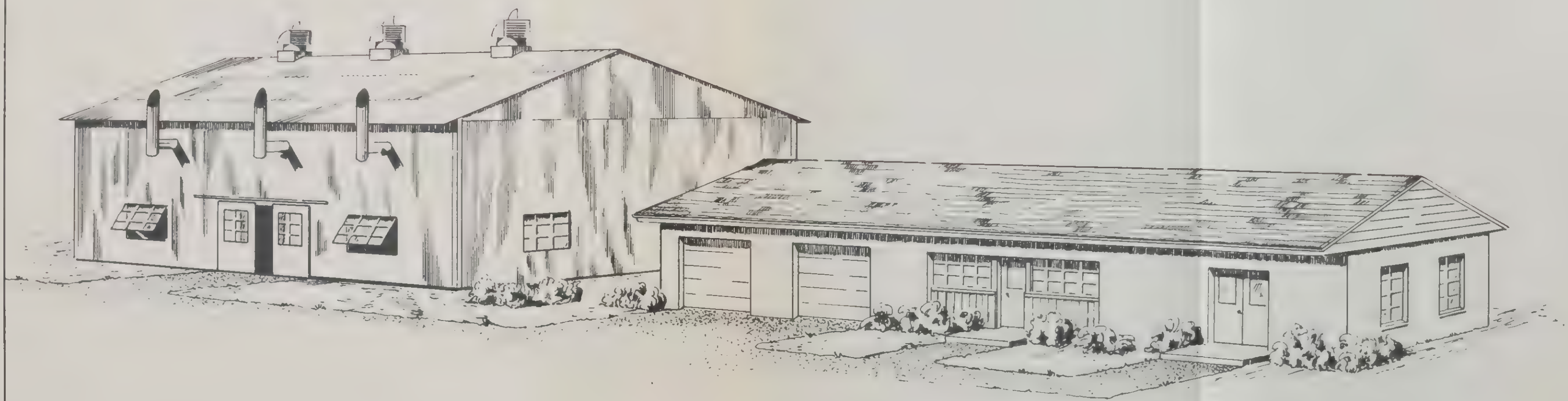
SCHEMATIC LAYOUT

EXHIBIT 28




OFFICE BUILDING PLAN

EXHIBIT 29



MAIN LINE

STATION BUILDING PERSPECTIVE

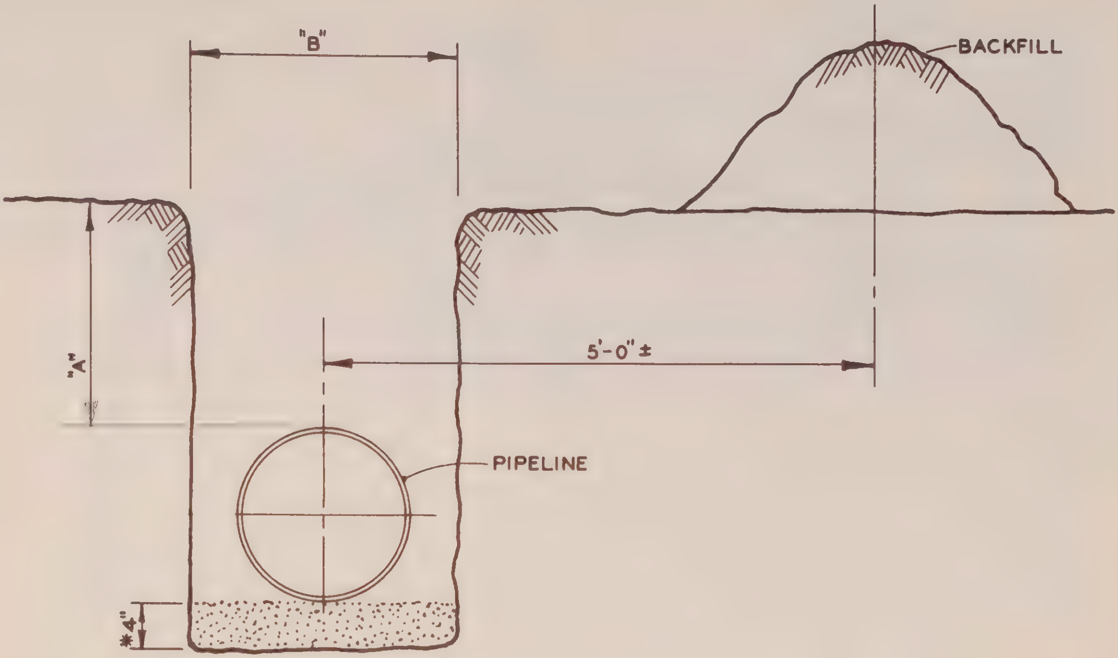
EXHIBIT 30

## 4. CONSTRUCTION EXHIBITS

Exhibits A through N on the following pages show proposed Main Line construction details. The titles of these exhibits are listed below. These exhibits are also presented in Volume II.

### List of Construction Exhibits

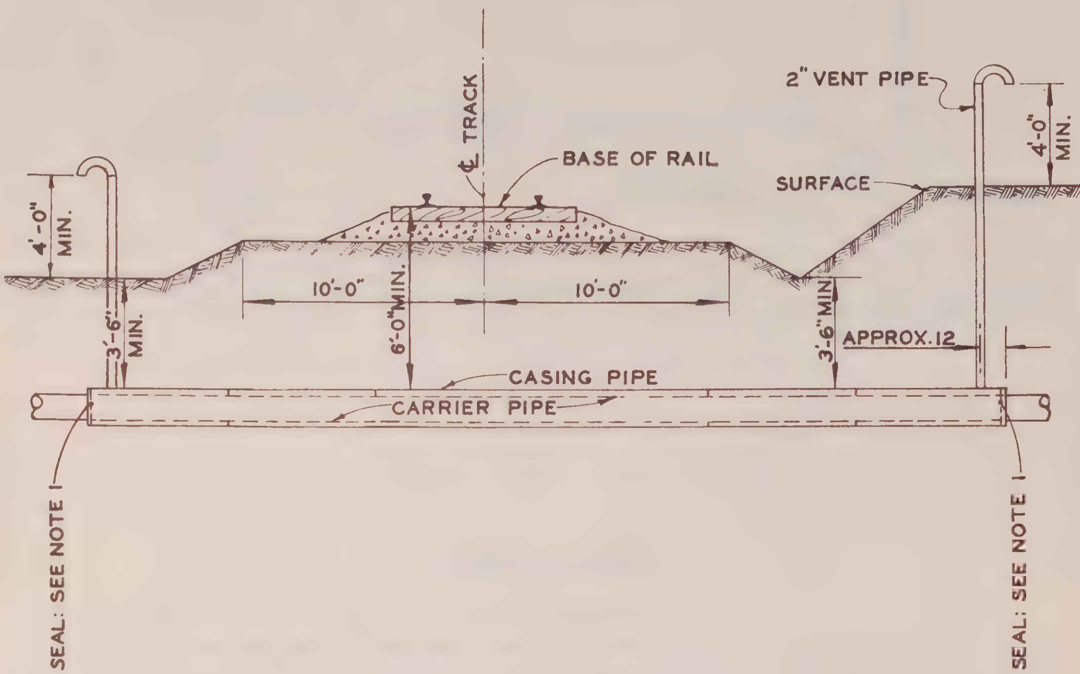
| No. | Title |
|---|---|
| A. | Minimum Ditch Requirements |
| B. | Specifications for Railroad Crossings |
| C. | Specifications for Highway Crossings |
| D. | Specifications for River Crossings |
| E. | Specifications for Electrolysis Test Stations |
| F. | Specifications for Aerial Markers |
| G. | Highway and Railroad Pipeline Markers |
| H. | Schedule of Main Line Gate Valves |
| I. | Specifications for Anchor Rods |
| J. | Specifications for Tile Repair |
| K. | Casing End Closure "Z" Gasket Installation |
| L. | Main Line Gate Valve Installation |
| M. | Details of Gate Installations |
| N. | Specifications for Insulating Flanges |




* 4" LOOSE EARTH PADDING REQUIRED IN BOTTOM OF DITCH FOR ROCK EXCAVATION WHERE NECESSARY.

| PIPE DIA. | MIN. DIM. "A" IN EARTH | MIN DIM. "A" IN ROCK | MIN. DIM. "B" EARTH OR ROCK |
|---|---|---|---|
| 16" | 36" | 20" | 26" |
| 18" | 36" | 20" | 28" |
| 20" | 36" | 20" | 30" |
| 26" | 36" | 20" | 36" |
| 30" | 36" | 20" | 40" |
| 34" | 36" | 20" | 44" |

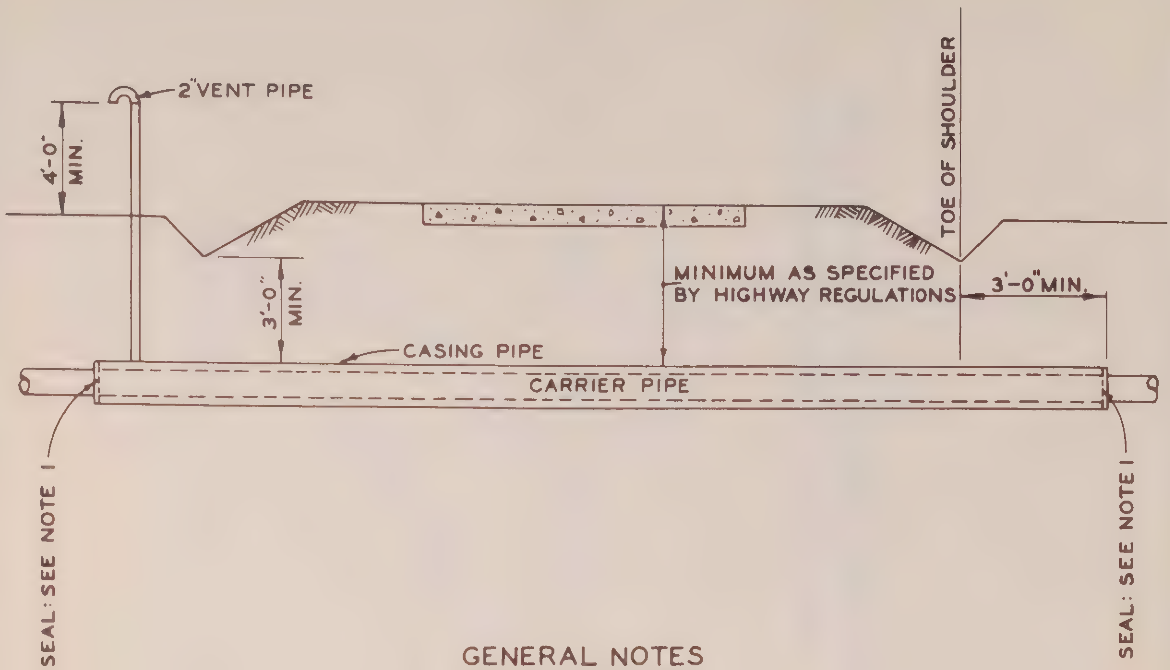
| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | MINIMUM<br>DITCH REQUIREMENTS | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C. B. D. | EXHIBIT A |
| TRACED | SCALE NONE | APPROVED C. J. F. | |




## GENERAL NOTES

1. SEAL CASING BUSHING, WILLIAMSON TYPE Z, EACH END.
2. PIPELINE SHALL NOT BE CONSTRUCTED UNDER RAILROAD RIGHT OF WAY AND TRACKS NEARER THAN SIX (6) FEET ON A LINE PERPENDICULARLY DISTANT FROM ANY RAIL JOINT IN SAID TRACK.
3. CASING PIPE SHALL BE PLACED UNDER ROADBED AND TRACKS BY THE JACKING OR BORING METHOD IN ALL CROSSINGS UNDER THIS PARTICULAR SPECIFICATION UNLESS INSTRUCTIONS TO THE CONTRARY ARE ISSUED BY THE COMPANY. THE TRENCH ON EACH SIDE OF THE TRACK SHALL BE PROMPTLY REFILLED IN A PROPER AND WORKMANLIKE MANNER. SO AS TO LEAVE NO HOLES OR OBSTRUCTIONS THEREIN AND SO AS TO FURNISH AND PROVIDE PROPER DRAINAGE.
4. WHERE, IN THE OPINION OF THE RAILROAD COMPANY'S CHIEF ENGINEER, DRAINAGE DITCHES OR OTHER CONDITIONS REQUIRE THE PIPE AND CASING TO BE BURIED TO A GREATER DEPTH, PIPE SHALL BE SO INSTALLED.
5. NO PIPE SHALL BE PLACED ON, UNDER, OR WITHIN 25 FEET OF, ANY BRIDGE, CULVERT, OR STRUCTURE, WITHOUT SPECIAL AUTHORITY OF RAILROAD COMPANY'S CHIEF ENGINEER.
6. CASING PIPE SHALL BE $\frac{3}{8}$" WALL WITH AN OUTSIDE DIAMETER 4" GREATER THAN THAT OF THE MAIN LINE PIPE.
7. IN ALL CASES THE SPECIFICATIONS OF THE OF THE RAILROAD COMPANY WHOSE FACILITIES ARE BEING CROSSED SHALL GOVERN.

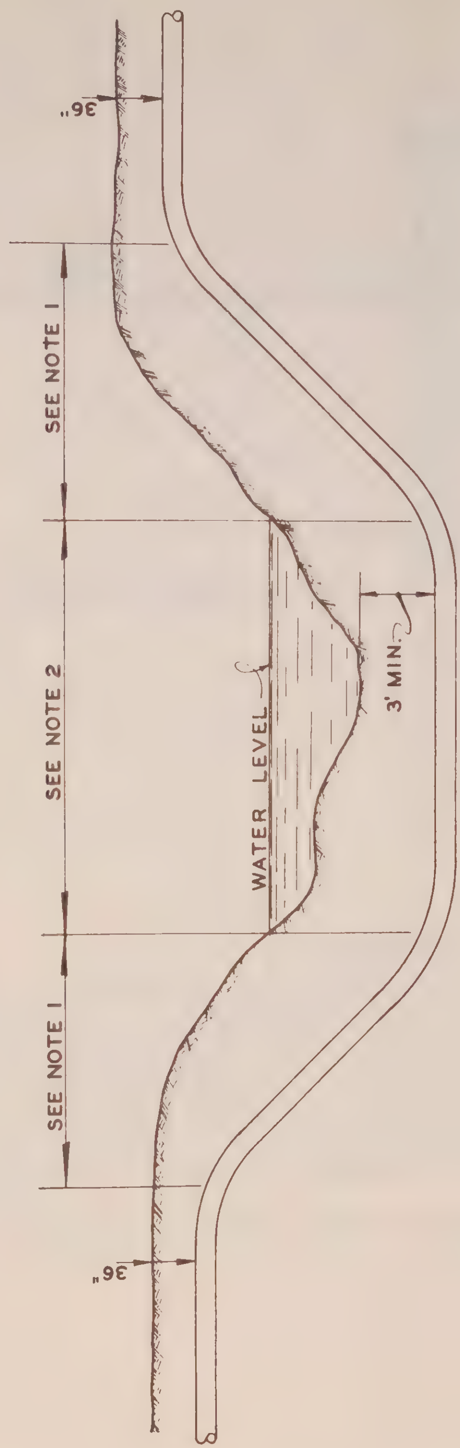
| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | SPECIFICATIONS FOR RAILROAD CROSSINGS | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C. B. D. | EXHIBIT B |
| TRACED | SCALE NONE | APPROVED C. J. F. | |




## GENERAL NOTES

1. SEAL CASING BUSHING, WILLIAMSON TYPE Z, EACH END.
2. BORING SHALL BE DONE BY AN APPROVED METHOD AND THE CASING SHALL BE ADVANCED AT A RATE APPROXIMATELY EQUAL TO THE RATE OF BORING. WHERE BORING IS NOT PRACTICAL, DUE TO ROCK STRATA OR OTHER OBSTRUCTIONS, THE CHIEF ENGINEER OF THE DEPARTMENT OF HIGHWAYS SHALL FIRST APPROVE ALL PLANS FOR CONSTRUCTION BY "OPEN CUT", "TUNNELING", OR OTHER METHODS.
3. IN REFILLING THE TRENCH EXCAVATED FOR THE PIPELINE, ADJACENT TO HARD SURFACED ROADS OR HIGHWAYS AND ACROSS ROADS WHERE TRENCHING IS PERMITTED, THE TRENCH SHALL BE PROMPTLY BACKFILLED IN A PROPER AND WORKMANLIKE MANNER SO AS TO LEAVE NO HOLES OR OBSTRUCTIONS THEREIN AND SO AS TO FURNISH AND PROVIDE PROPER DRAINAGE.
4. CASING PIPE SHALL BE $\frac{3}{8}$" WALL WITH AN OUTSIDE DIAMETER 4" GREATER THAN THAT OF THE MAIN LINE PIPE.
5. LOCATE VENT ACCORDING TO HIGHWAY DEPT. INSTRUCTIONS.

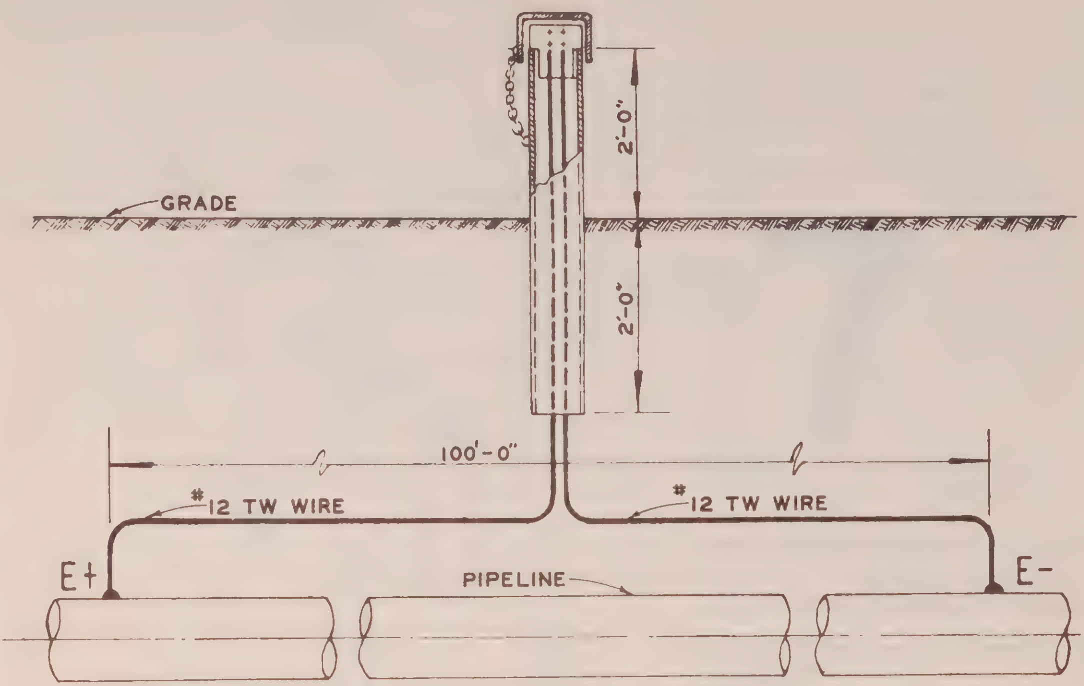
| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | SPECIFICATIONS FOR HIGHWAY CROSSINGS | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C. B. D. | EXHIBIT C |
| TRACED | SCALE NONE | APPROVED C. J. F. | |




NOTES:

1. PIPE TO BE LAID TO EXTRA DEPTH AT THESE LOCATIONS TO PREVENT EXCESSIVE BENDING.
2. RIVER PIPE TO BE LEVEL UNDER RIVER CHANNEL EXCEPT IN ROCK FORMATIONS WHERE PIPE MAY BE LAID A MINIMUM OF 3' BELOW RIVER BED.

| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | SPECIFICATIONS FOR<br>RIVER CROSSINGS | |
|---|---|---|---|
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C.B.D. | EXHIBIT D |
| TRACED | SCALE NONE | APPROVED C.J.F. | |

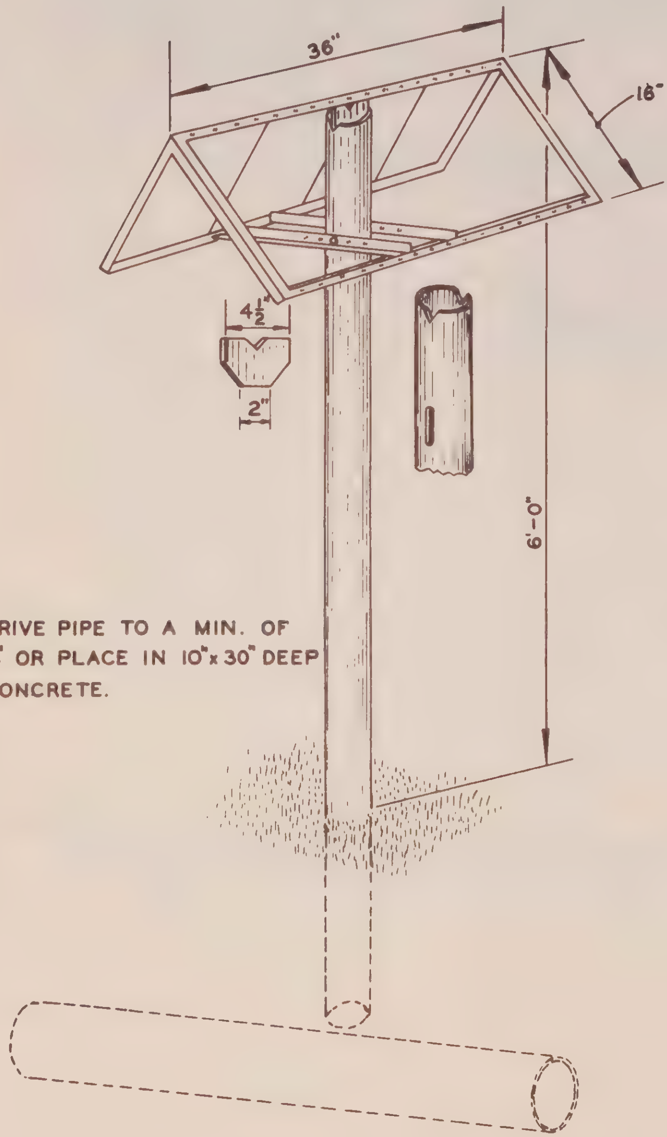



## GENERAL NOTES

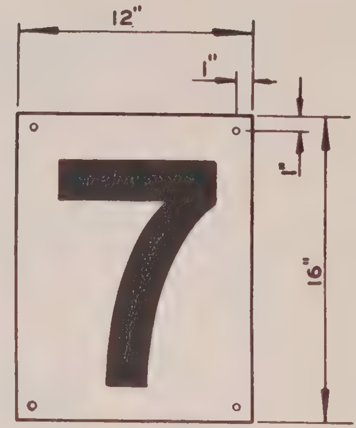
1. STD. WT. 2" PIPE BURIED 2' IN GROUND AND 2' ABOVE GROUND. WIRES TIED TO SERVICE ENGINEERS INC. 2 SIZE PLASTIC TERMINAL BOARD AND PIPE CAPPED WITH 2" SIZE SERVICE ENGINEERS INC. ELECTROLYSIS CHECK POINT ALUMINUM CAP WITH CHAIN SPOT WELDED OR BRAZED TO THE 2" PIPE 8" BELOW TOP OF PIPE.
2. WIRES TO BE SOLID TW COVERED #12 COPPER WIRE FURNISHED BY THE COMPANY.
3. WIRES TO BE WELDED TO PIPE BY THE CADWELD PROCESS AND INSULATED WITH ENAMEL AND ASBESTOS FELT PAPER OR ADHESIVE TAPE. MATERIAL TO BE FURNISHED BY THE COMPANY.
4. LAY WIRES IN TRENCH BESIDE PIPE, NOT UNDER OR OVER PIPE.

| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | SPECIFICATIONS FOR<br>ELECTROLYSIS<br>TEST STATIONS | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C. B. D. | EXHIBIT E |
| TRACED | SCALE NONE | APPROVED C. J. F. | |

MARKER TO BE MOUNTED ON 4" PIPE.
WEDGE USED TO ATTACH TOP MEMBER.
BOLT USED TO ATTACH BOTTOM MEMBER.
ALL FRAME TO BE 1"x 1"x $\frac{3}{16}$" ANGLE.




DRIVE PIPE TO A MIN. OF 4' OR PLACE IN 10"x 30" DEEP CONCRETE.

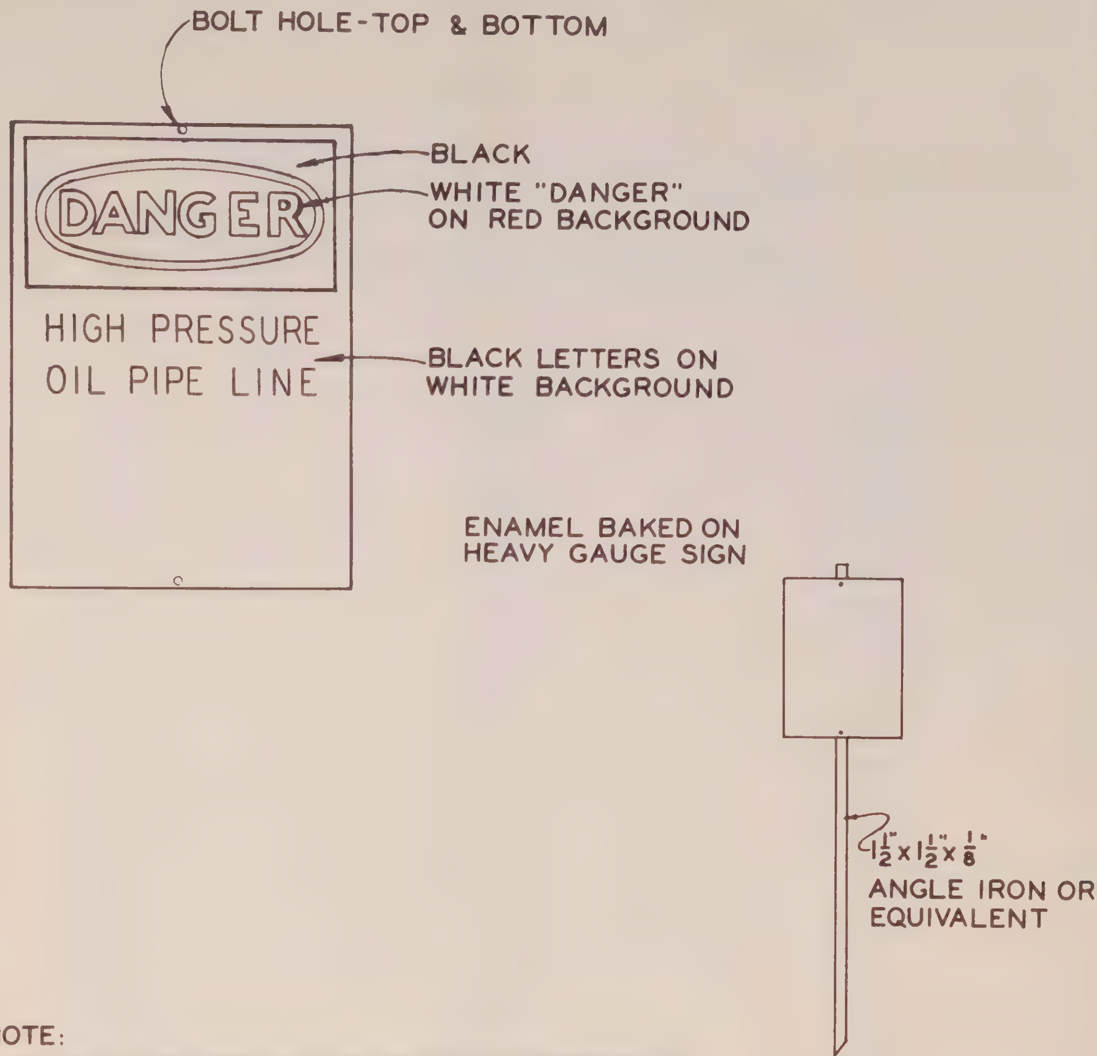



BACKGROUND COLOR TO BE BRIGHT ORANGE OR CHROME YELLOW.
ALL NUMERALS TO BE DEAD BLACK.

ATTACH NUMERALS TO ARMS WITH $\frac{1}{8}$"$\phi$ BOLTS.

NUMERAL PLATES TO HAVE PORCELAIN FINISH. ALL OTHER METAL TO HAVE PROTECTIVE ALUMINUM COATING.

| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | SPECIFICATIONS FOR AERIAL MARKERS | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C. B. D. | EXHIBIT F |
| TRACED | SCALE NONE | APPROVED C. J. F. | |




NOTE:
TO BE PLACED OVER THE PIPELINE ON EACH BOUNDARY OF EACH HIGHWAY, PUBLIC ROAD, OR RAILROAD RIGHT OF WAY.

| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | HIGHWAY AND RAILROAD PIPELINE MARKERS | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C.B.D. | EXHIBIT G |
| TRACED | SCALE NONE | APPROVED C.J.F. | |

## EXHIBIT H

## SCHEDULE OF MAIN LINE GATE VALVES

Location - Milepost Measured from Edmonton

| | | |
|---|---|---|
| 124.3 | 745.0 | 1380.0 |
| 150.2 | 766.8 | 1424.0 |
| 176.7 | 810.0 | 1440.0 |
| 193.9 | 834.0 | 1489.6 |
| 241.2 | 878.0 | 1508.6 |
| 267.5 | 900.0 | 1549.4 |
| 293.7 | 923.0 | 1569.2 |
| 329.0 | 964.0 | 1589.3 |
| 370.5 | 984.0 | 1609.2 |
| 391.0 | 1003.8 | 1652.0 |
| 411.6 | 1024.5 | 1675.0 |
| 452.5 | 1068.2 | 1699.6 |
| 471.3 | 1091.9 | 1721.7 |
| 490.0 | 1112.3 | 1770.5 |
| 511.7 | 1137.5 | 1794.8 |
| 553.2 | 1180.5 | 1839.4 |
| 577.7 | 1203.0 | 1862.4 |
| 600.2 | 1223.9 | 1909.5 |
| 638.5 | 1267.3 | 1931.2 |
| 661.0 | 1290.0 | 1954.0 |
| 684.0 | 1310.4 | 1998.8 |
| 727.8 | 1355.5 | |

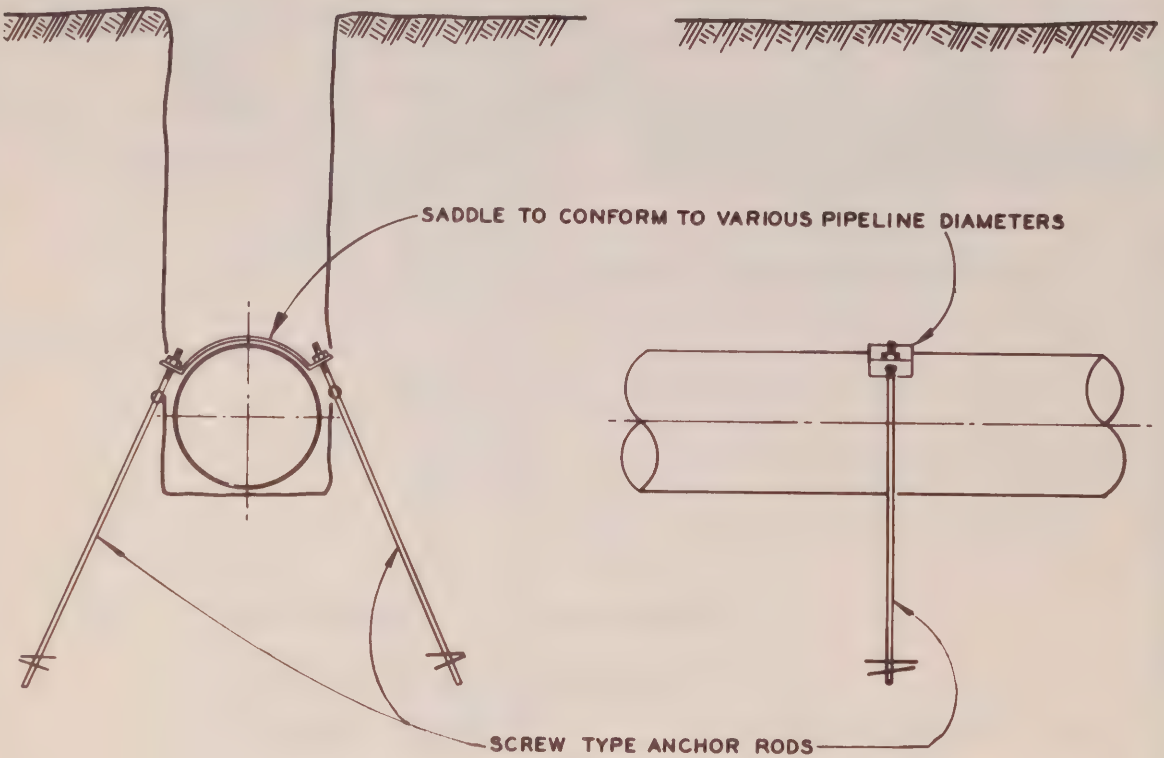
TOTAL 65 Gate Valves, Main Line

Calgary Lateral
(MP measured from Calgary)

| for 10 3/4" O. D. Pipe | for 16" O. D. Pipe |
|---|---|
| 14.5 | 93.2 |
| 31.4 | 114.8 |
| 43.0 | |
| 59.5 | |

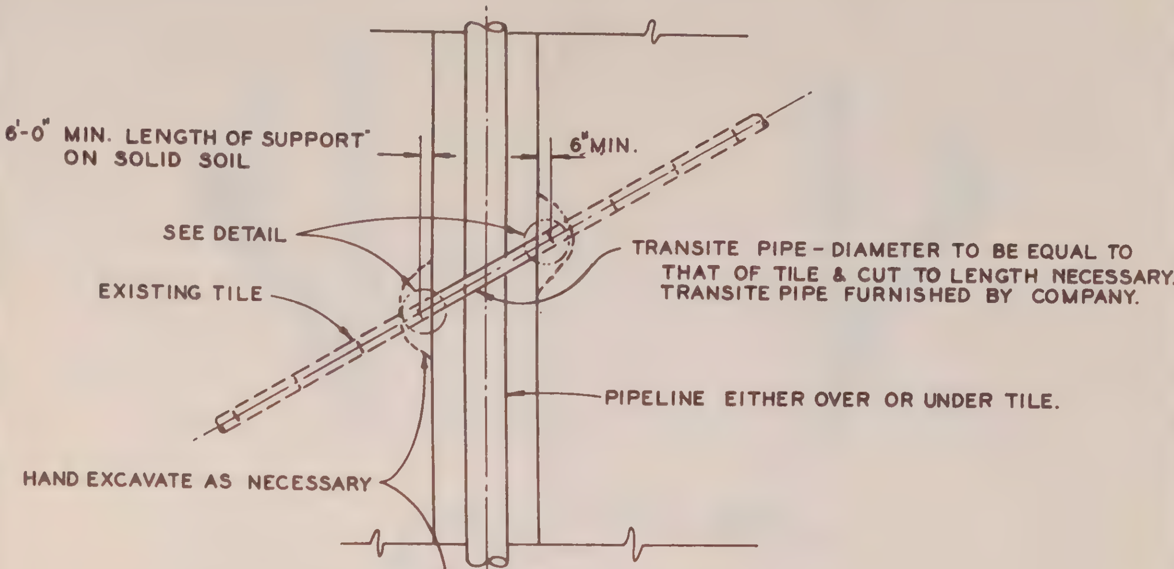
Edmonton Lateral (26" O. D. Pipe)
(MP measured from Edmonton)

| |
|---|
| 21.2 |
| 41.9 |
| 65.5 |
| 82.3 |

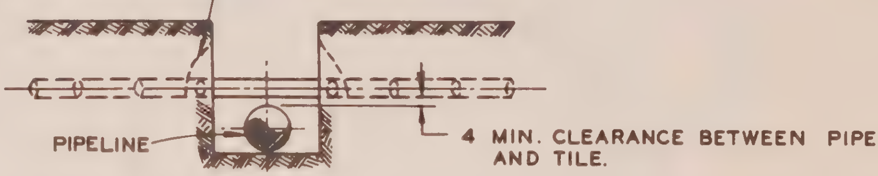



NOTE: LOCATION AND SPACING TO BE DETERMINED BY FIELD ENGINEER.
TO BE INSTALLED IN AREAS SUBJECT TO POSSIBLE INUNDATION PRIOR TO CONSOLIDATION OF THE BACKFILL.

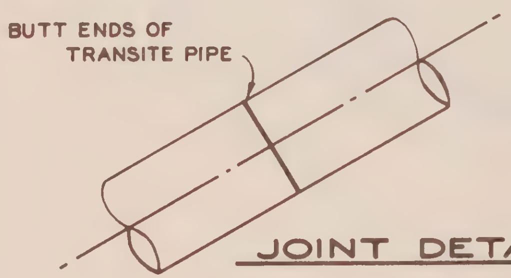
| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | SPECIFICATIONS FOR<br>ANCHOR RODS | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C. B. D. | EXHIBIT I |
| TRACED | SCALE NONE | APPROVED C. J. F. | |




PLAN

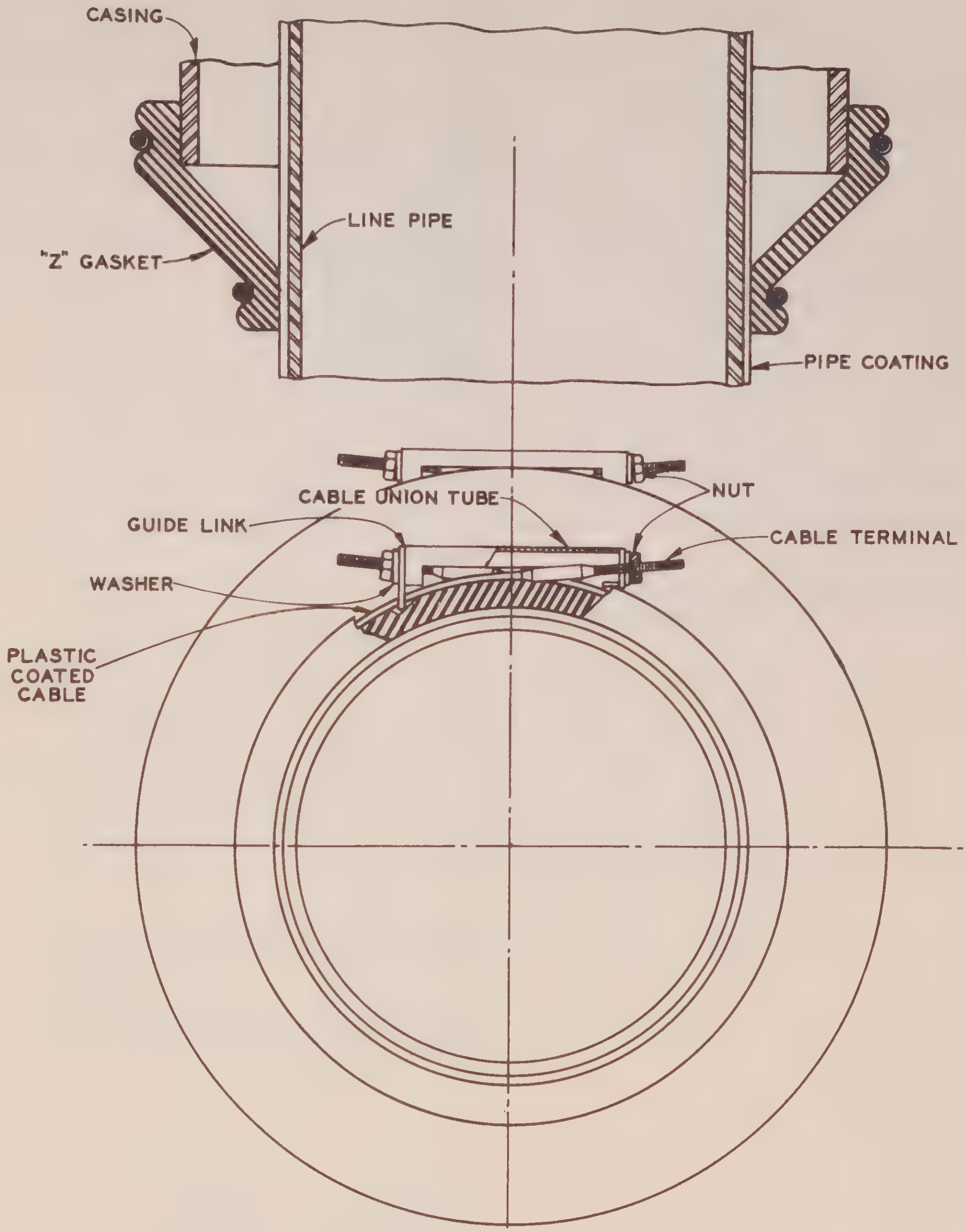



ELEVATION

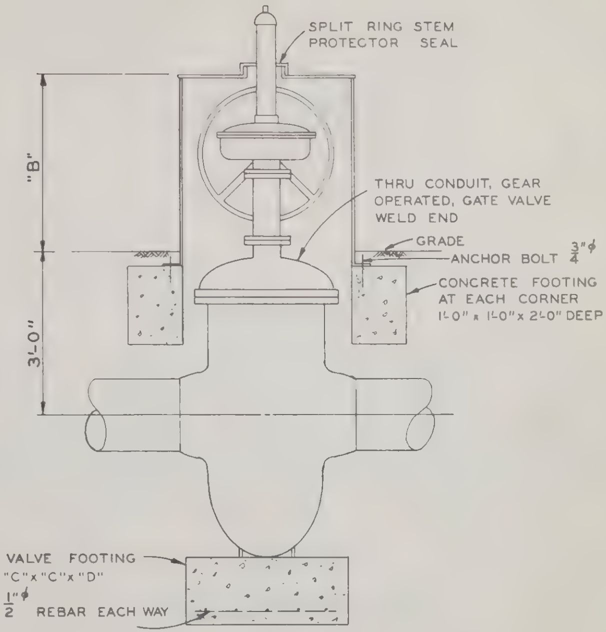


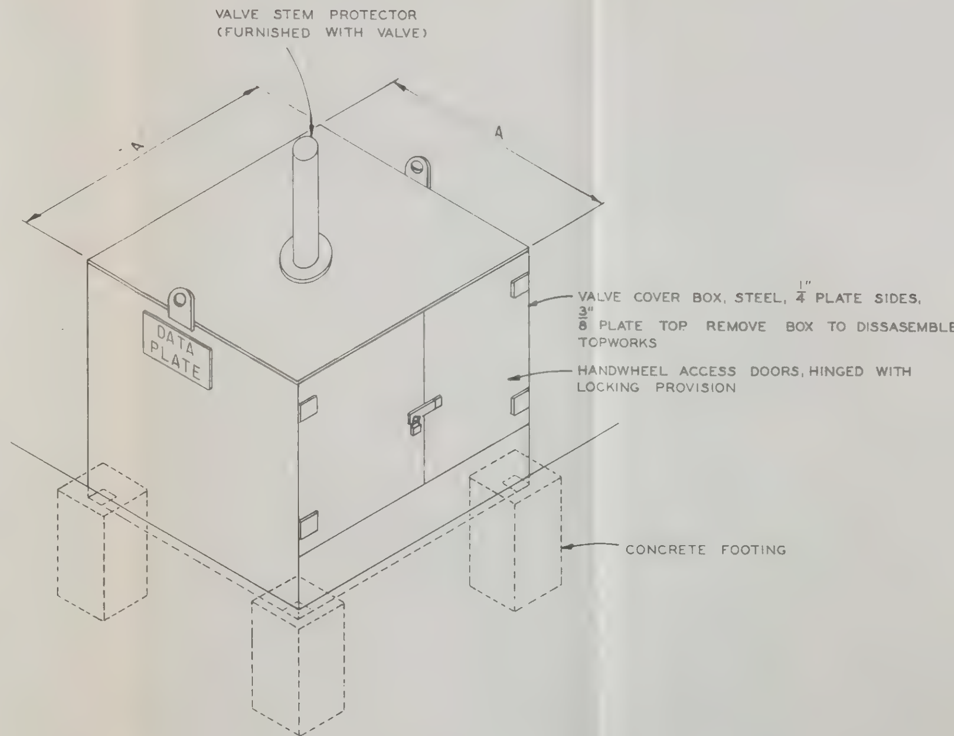

JOINT DETAIL

| | | | | |
|---|---|---|---|---|
| DUTTON - WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | SPECIFICATIONS FOR<br>TILE REPAIR | | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C. B. D. | | EXHIBIT J |
| TRACED | SCALE NONE | APPROVED C. J. F. | | |




| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | CASING END CLOSURE<br>"Z" GASKET INSTALLATION | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C.B.D. | EXHIBIT K |
| TRACED | SCALE NONE | APPROVED C.J.F. | |




| VALVE SIZE | A | B | C | D |
|---|---|---|---|---|
| 16" | 38" | 41" | 36" | 15" |
| 18" | 38" | 45" | 38" | 15" |
| 20" | 48" | 51" | 40" | 15" |
| 26" | 50" | 69" | 46" | 18" |
| 30" | 56" | 78" | 50" | 18" |
| 34" | 60" | 85" | 60" | 18" |

DUTTON-WILLIAMS BROTHERS LIMITED
ENGINEERS — CONSTRUCTORS
CALGARY, ALBERTA

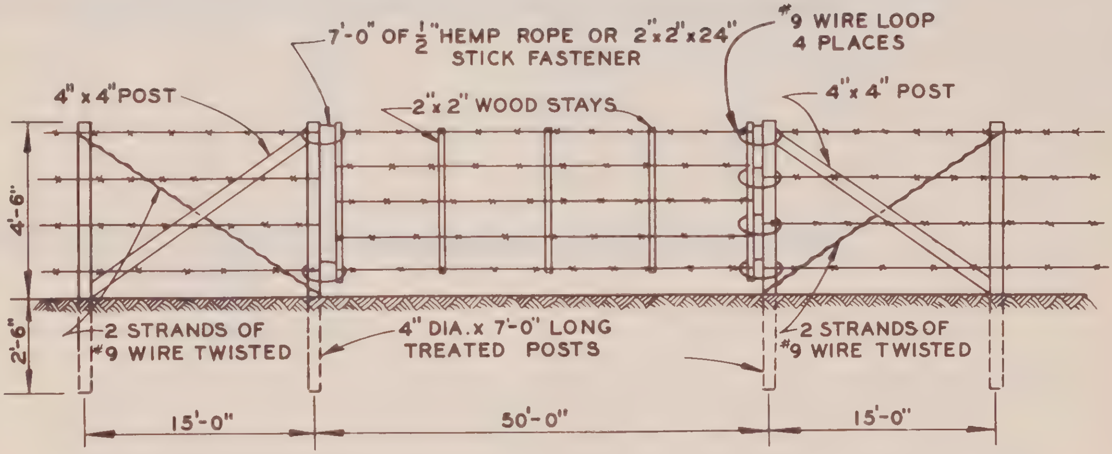
MAIN LINE GATE VALVE INSTALLATION

DRAWN ZEVNIK | DATE 2-1-58 | CHECKED C.B D.
TRACED | SCALE NONE | APPROVED C. J. F.

EXHIBIT L

OFFSET METHOD

TO BE USED AT CUTS




GATE INSTALLATION

NOTE: REBUILD FENCES TO ORIGINAL POST SPACING REMOVING ALL BRACES AND TIES.

| | | | |
|---|---|---|---|
| DUTTON-WILLIAMS BROTHERS LIMITED<br>ENGINEERS — CONSTRUCTORS<br>CALGARY, ALBERTA | | DETAILS OF<br>GATE INSTALLATIONS | |
| DRAWN ROGERS | DATE 2-1-58 | CHECKED C.B.D. | EXHIBIT M |
| TRACED | SCALE NONE | APPROVED C.J.F. | |

# CHAPTER II

# ECONOMIC STUDIES

## A. ESTIMATED INVESTMENT REQUIREMENTS

### 1. SUMMARY

Capital requirements are summarized on the following page, and presented in detail on succeeding pages. Investment costs were derived from an analysis of preliminary design drawings for the pumping stations and terminal facilities, field investigation of the pipeline traverse, and detailed cost comparison of pipe prices delivered along the traverse from quotations by pipe manufacturers. Other capital requirements were developed from empirical data for this particular project. Such items as financing cost, working capital and interest during construction are derived under Section C, Financial Data.

The capital requirements summarized below serve as aids in financing and in calculation of operating costs and revenue requirements. Four systems are shown, the 30-inch and 34-inch systems for both the Southern Route and the Northern Route. Since the Southern Route is most economical, costs were prepared in detail for this Route. For the Northern Route, some costs were prepared in detail while others were adapted from the Southern Route where the possible error was insignificant. A buildup of costs for each of the ten years as stations and other facilities are added periodically is shown in the details and under Financial Data. Only the first and tenth year figures are shown on the following page to maintain conciseness in the summary.

## SUMMARY OF ESTIMATED CAPITAL REQUIREMENTS

(000 Omitted)

| | Southern Route | | | | Northern Route | | | |
|---|---|---|---|---|---|---|---|---|
| | 30-Inch System | | 34-Inch System | | 30-Inch System | | 34-Inch System | |
| | 1960 | 1969 | 1960 | 1969 | 1960 | 1969 | 1960 | 1969 |
| 1. Pipelines | $286,472 | $286,472 | $330,326 | $330,326 | $328,115 | $328,115 | $383,597 | $383,597 |
| 2. Stations and Terminals | 20,990 | 45,628 | 17,433 | 31,248 | 22,740 | 50,958 | 19,105 | 35,417 |
| Total System Cost | $307,462 | $332,100 | $347,759 | $361,574 | $350,855 | $379,073 | $402,702 | $419,014 |
| 3. Interest During Construction | $ 12,107 | $ 12,629 | $ 13,693 | $ 13,985 | $ 13,815 | $ 14,414 | $ 15,856 | $ 16,202 |
| 4. Working Capital | 1,884 | 1,884 | 1,370 | 1,370 | 2,009 | 2,009 | 1,478 | 1,478 |
| 5. Financing Costs | 7,776 | 7,776 | 8,440 | 8,440 | 8,714 | 8,714 | 9,676 | 9,676 |
| 6. Line Fill | 24,089 | 24,089 | 30,729 | 30,729 | 25,458 | 25,458 | 30,729 | 30,729 |
| Total Capital Requirement | $353,318 | $378,478 | $401,991 | $416,098 | $400,851 | $429,668 | $460,441 | $477,099 |

2. BASIS OF COSTS

Costs detailed on the following pages are based on these conditions:

a. It is assumed that the construction period would be from July 1, 1958 to December, 1959. Throughput would begin on January 1, 1960.

b. All costs are based on a rate of exchange of one Canadian dollar equals one United States dollar. Under present trends, it would appear advantageous to purchase imports as soon as possible.

c. All costs are based on present prices except for pipe. Pipe costs have been increased seven dollars per ton over present prices in anticipation of such approximate increase effective July 1. If pipe costs are further increased in 1959, such increase must be covered by the five percent contingency factor added to pipeline costs.

d. Present indications from pipe manufacturers indicate that if pipe orders were placed by April 1, 1958, deliveries could start by July 1, on 26-inch and larger pipe, and immediately for the 16-inch and smaller sizes.

e. Canadian mills could roll 100 miles per month of 30-inch pipe, but supply only 200 miles per year in each 1958 and 1959 of any pipe over 30-inch because of plate width (subject to change at time of order). U. S. mills can presently guarantee full delivery within the construction period. However, it is urgent that commitments for pipe be made as soon as possible to insure delivery as required.

f. A Canadian duty of 22-1/2 percent has been assumed for pipe 10-3/4-inch OD and less, and for valves and pipeline accessories necessarily imported from the United States. A duty of 15 percent has been assumed on imported pipe larger than 10-3/4-inch OD. All material prices include Dominion sales tax of 10%, and provincial and state sales tax where applicable as follows: Saskatchewan, 3%; North Dakota, 2%; Michigan, 3%; and Quebec, 2%.

g. After inclusion of Canadian duty, U. S. pipe is slightly more expensive than Canadian pipe. Canadian pipe would thus be used where possible. However, considering the possibility that present delivery promises may change by the time firm

orders are placed, pipe has been assumed originating from the following sources for the various alternates:

| Source | Smaller Pipe | Southern Route Canadian Part 30" | | Southern Route U. S. Part 30" | | Northern Route 30" | |
|---|---|---|---|---|---|---|---|
| | | 30" | 34" | 30" | 34" | 30" | 34" |
| Canada | 100% | 50% | 32.8% | | | 62.5% | 20% |
| U. S. A. | | 50% | 67.2% | 100% | 100% | 37.5% | 80% |

h. No drawback of Canadian duty or Dominion sales tax has been considered.

i. Communications facilities are assumed leased wire and therefore are shown as operating rather than investment costs.

j. All pumps in pump stations are assumed powered by engines using crude oil from the pipeline for fuel.

k. A factor for contingencies and omissions is included in investment costs as five percent for the pipeline system and ten percent for pump stations and terminals.

l. Engineering-management costs of seven percent as shown include (1) preparation of detailed engineering design, specifications, bills of material, and contract documents; (2) field survey, including staking right-of-way, preparation of plans and profiles, and inventory survey and maps; (3) right-of-way acquisition, including negotiations with owners but not including payments to owners; (4) negotiations of damage claims, but not including damage payments; (5) material procurement, expediting and shipping, including solicitation of competitive quotations, mill inspection of pipe, routing, receiving reports, and filing loss and damage claims with carrier and insurance companies; (6) construction inspection, including customary radiographic or X-ray welding inspection, and visual inspection of plant work, right-of-way, grade and alignment, ditch, welding, bending, coating, backfill and cleanup; (7) field engineering and administration of construction, including progress reports, automotive and field office expense, cost accounting, as-built drawings and supervision of testing the completed system.

m. Some detailed costs are shown only in summary for the sake of conciseness in report presentation. Details are available upon request to substantiate the items shown.

## 3. ANALYSIS OF PIPE REQUIREMENTS

| | 30-Inch System | | | | 34-Inch System | | | |
|---|---|---|---|---|---|---|---|---|
| | Dia. | Wall | Miles | Tons | Dia. | Wall | Miles | Tons |
| Alberta: | 26" | 13/32 | 6.65 | 1,949.6 | 26" | 13/36 | 6.65 | 1,949.6 |
| | | 3/8 | 7.85 | 2,126.9 | | 3/8 | 7.85 | 2,126.9 |
| | | 11/32 | 9.5 | 2,362.3 | | 11/32 | 9.5 | 2,362.3 |
| | | 5/16 | 76.0 | 17,201.6 | | 5/16 | 76.0 | 17,201.1 |
| | 30" | 13/32 | 9.6 | 3,254.2 | 34" | 7/16 | 1.0 | 414.0 |
| | | 3/8 | 34.1 | 10,681.5 | | 13/32 | 13.0 | 5,002.5 |
| | | 11/32 | 20.1 | 5,777.5 | | 3/8 | 56.5 | 20,087.4 |
| | | 5/16 | 12.9 | 3,374.3 | | 11/32 | 6.0 | 1,957.2 |
| | 16" | 1/4 | 71.5 | 7,937.2 | | 5/16 | 0.2 | 59.4 |
| | 10 3/4" | 1/4 | 73.5 | 5,441.2 | 16" | 1/4 | 71.5 | 7,937.2 |
| Sub-Total | | | 321.70 | 60,106.3 | 10 3/4" | 1/4 | 73.5 | 5,441.2 |
| | | | | | | | 321.70 | 64,538.8 |
| Saskatchewan: | 30" | 13/32 | 85.2 | 28,881.1 | 34" | 7/16 | 0.6 | 248.4 |
| | | 3/8 | 82.2 | 25,748.3 | | 13/32 | 64.3 | 24,743.3 |
| | | 11/32 | 47.0 | 13,509.7 | | 3/8 | 77.4 | 27,518.0 |
| | | 5/16 | 198.2 | 51,843.2 | | 11/32 | 86.5 | 28,216.3 |
| | 24" | 1/2 | 1.52 | 503.6 | | 5/16 | 183.8 | 54,555.5 |
| Sub-Total | | | 413.3 | 120,485.6 | 24" | 1/2 | 1.52 | 503.6 |
| | | | | | | | 413.3 | 135,820.1 |
| Manitoba: | 30" | 13/32 | 34.1 | 11,559.2 | 34" | 13/32 | 27.5 | 10,582.3 |
| | | 3/8 | 14.5 | 4,542.0 | | 11/32 | 47.5 | 15,494.5 |
| | | 11/32 | 10.8 | 3,104.4 | | 5/16 | 38.5 | 11,427.6 |
| | | 5/16 | 54.1 | 14,150.9 | | | 113.5 | 37,504.4 |
| Sub-Total | | | 113.5 | 33,356.5 | | | | |
| North Dakota: | 30" | 13/32 | 11.0 | 3,727.9 | 34" | 13/32 | 0.5 | 192.4 |
| | | 3/8 | 10.5 | 3,289.0 | | 3/8 | 15.0 | 5,332.9 |
| | | 11/32 | 11.5 | 3,305.6 | | 11/32 | 47.0 | 15,331.4 |
| | | 5/16 | 72.5 | 18,963.8 | | 5/16 | 43.0 | 12,763.2 |
| Sub-Total | | | 105.5 | 29,286.3 | | | 105.5 | 33,619.9 |

## 3. ANALYSIS OF PIPE REQUIREMENTS (Continued)

| | 30-Inch System | | | | 34-Inch System | | | |
|---|---|---|---|---|---|---|---|---|
| | Dia. | Wall | Miles | Tons | Dia. | Wall | Miles | Tons |
| Minnesota: | 30" | 7/16 | 6.5 | 2,370.3 | 34" | 13/32 | 28.9 | 11,121.0 |
| | | 13/32 | 44.5 | 15,081.1 | | 3/8 | 42.5 | 15,110.0 |
| | | 3/8 | 21.0 | 6,578.0 | | 11/32 | 70.5 | 22,997.1 |
| | | 11/32 | 19.5 | 5,605.1 | | 5/16 | 120.1 | 35,648.1 |
| | | 5/16 | 170.5 | 44,597.9 | | | 262.0 | 84,876.2 |
| | | | 262.0 | 74,232.4 | | | | |
| Wisconsin: | 30" | 7/16 | 20.5 | 7,475.5 | 34" | 13/32 | 9.2 | 3,540.2 |
| | | 13/32 | 10.6 | 3,592.3 | | 3/8 | 16.6 | 5,866.2 |
| | | 3/8 | 19.4 | 6,076.9 | | 11/32 | 46.1 | 15,005.2 |
| | | 11/32 | 37.7 | 10,836.5 | | 5/16 | 28.6 | 8,459.4 |
| | | 5/16 | 12.3 | 3,217.3 | | | 100.5 | 32,871.0 |
| | | | 100.5 | 31,199.5 | | | | |
| Michigan: | 30" | 13/32 | 21.8 | 7,388.0 | 34" | 13/32 | 28.1 | 10,813.2 |
| | | 3/8 | 32.5 | 10,180.3 | | 3/8 | 65.4 | 23,251.7 |
| | | 11/32 | 82.5 | 23,713.8 | | 11/32 | 42.0 | 13,700.4 |
| | | 5/16 | 161.0 | 42,269.7 | | 5/16 | 162.3 | 48,173.9 |
| | 24" | 1/2 | 3.5 | 1,166.8 | 24" | 1/2 | 3.5 | 1,166.1 |
| | | | 301.3 | 84,718.6 | | | 301.3 | 97,105.3 |
| Ontario: | 30" | 13/32 | 60.8 | 20,605.1 | 34" | 13/32 | 91.3 | 35,133.2 |
| | | 3/8 | 48.9 | 15,317.4 | | 3/8 | 98.2 | 34,913.0 |
| | | 11/32 | 99.0 | 28,456.6 | | 11/32 | 93.2 | 30,401.8 |
| | | 5/16 | 296.3 | 77,503.2 | | 5/16 | 222.3 | 65,983.1 |
| | | | 505.0 | 141,887.3 | | | 505.0 | 166,431.1 |
| Quebec: | 30" | 5/16 | 42.5 | 11,116.7 | 34" | 5/16 | 42.5 | 12,614.8 |
| | 24" | 1/2 | 1.0 | 331.3 | 24" | 1/2 | 1.0 | 331.29 |
| | | | 43.5 | 11,448.0 | | | 43.5 | 12,946.1 |

## 4. PIPELINE CONSTRUCTION COSTS

### a. Summary - Total Pipeline

(000 OMITTED)

| Section | Province or State | FIRST YEAR PROGRAM (1958) Material Cost | Installation Cost | Total Cost | SECOND YEAR PROGRAM (1959) Material Cost | Installation Cost | Total Cost | Grand Totals |
|---|---|---|---|---|---|---|---|---|
| Western | Alberta | $ 8,873 | $ 2,734 | $11,607 | $ 9,853 | $ 2,961 | $12,814 | $24,421 |
| | Saskatchewan | 16,872 | 5,233 | 22,105 | 20,906 | 7,081 | 27,987 | 50,092 |
| | Manitoba | - | - | - | 10,025 | 3,155 | 13,180 | 13,180 |
| | Direct Pipeline Cost | 25,745 | 7,967 | 33,712 | 40,784 | 13,197 | 53,981 | 87,693 |
| | Contingencies | | | 1,686 | | | 2,699 | 4,385 |
| | Engineering and Management | | | 2,485 | | | 3,979 | 6,464 |
| | Total Pipeline Cost - Western Section | | | 37,883 | | | 60,659 | 98,542 |
| Central | North Dakota | - | - | - | 7,269 | 2,999 | 10,268 | 10,268 |
| | Minnesota | 11,070 | 5,290 | 16,360 | 6,749 | 3,232 | 9,981 | 26,341 |
| | Wisconsin | - | - | - | 7,299 | 3,563 | 10,862 | 10,862 |
| | Michigan | 7,912 | 6,053 | 13,965 | 13,024 | 7,879 | 20,903 | 34,868 |
| | Direct Pipeline Cost | 18,982 | 11,343 | 30,325 | 34,341 | 17,673 | 52,014 | 82,339 |
| | Contingencies | | | 1,517 | | | 2,601 | 4,118 |
| | Engineering and Management | | | 2,235 | | | 3,835 | 6,070 |
| | Total Pipeline Cost - Central Section | | | 34,077 | | | 58,450 | 92,527 |
| Eastern | Ontario | 15,204 | 14,311 | 29,515 | 25,409 | 21,982 | 47,391 | 76,906 |
| | Quebec | 3,756 | 2,344 | 6,100 | 316 | 1,575 | 1,891 | 7,991 |
| | Direct Pipeline Cost | 18,960 | 16,655 | 35,615 | 25,725 | 23,557 | 49,282 | 84,897 |
| | Contingencies | | | 1,781 | | | 2,464 | 4,245 |
| | Engineering and Management | | | 2,626 | | | 3,635 | 6,261 |
| | Total Pipeline Cost - Eastern Section | | | 40,022 | | | 55,381 | 95,403 |
| | Total Pipeline Cost | | | 111,982 | | | 174,490 | 286,472 |

b. Details - Western Section, Pipeline

| A. Materials - Western Section | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| 1. Right of Way Easements and Damages | | | |
| (a) Alberta | $ 152,250 | $ 187,050 | $ 339,300 |
| (b) Saskatchewan | 204,750 | 248,400 | 453,150 |
| (c) Manitoba | - | 165,000 | 165,000 |
| Total | 357,000 | 600,450 | 957,450 |
| 2. Pipe | | | |
| (a) Alberta | 5,933,520 | 7,072,595 | 13,006,115 |
| (b) Saskatchewan | 11,151,508 | 13,736,634 | 24,888,142 |
| (c) Manitoba | - | 6,882,511 | 6,882,511 |
| Total | 17,085,028 | 27,691,740 | 44,776,768 |
| 3. Pipe Freight | | | |
| (a) Alberta | 1,275,451 | 1,161,301 | 2,436,752 |
| (b) Saskatchewan | 1,854,626 | 2,278,971 | 4,133,597 |
| (c) Manitoba | - | 968,992 | 968,992 |
| Total | 3,130,077 | 4,409,264 | 7,539,341 |
| 4. Highway and Railway Crossings | | | |
| (a) Alberta | 14,372 | 29,060 | 43,432 |
| (b) Saskatchewan | 51,100 | 74,980 | 126,080 |
| (c) Manitoba | - | 41,495 | 41,495 |
| Total | 65,472 | 145,535 | 211,007 |
| 5. Coating Materials | | | |
| (a) Alberta | 300,010 | 358,838 | 658,848 |
| (b) Saskatchewan | 555,274 | 669,444 | 1,224,718 |
| (c) Manitoba | - | 352,709 | 352,709 |
| Total | 855,284 | 1,380,991 | 2,236,275 |

| A. Materials (Continued) | | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|---|
| 6. Concrete Weights | | | | |
| (a) Alberta | | $ 7,500 | $ 17,000 | $ 24,500 |
| (b) Saskatchewan | | 37,500 | 90,000 | 127,500 |
| (c) Manitoba | | - | 30,000 | 30,000 |
| | Total | 45,000 | 137,000 | 182,000 |
| 7. Mainline Valve Assemblies | | | | |
| (a) Alberta | | 40,540 | 57,520 | 98,060 |
| (b) Saskatchewan | | 111,510 | 127,440 | 238,950 |
| (c) Manitoba | | - | 63,720 | 63,720 |
| | Total | 152,050 | 248,680 | 400,730 |
| 8. Scraper Traps | | | | |
| (a) Alberta | | 51,720 | 85,280 | 137,000 |
| (b) Saskatchewan | | 155,200 | 232,800 | 388,000 |
| (c) Manitoba | | - | 116,400 | 116,400 |
| | Total | 206,920 | 434,480 | 641,400 |
| 9. River Crossing Manifolds | | | | |
| (a) Alberta | | - | - | - |
| (b) Saskatchewan | | - | 39,700 | 39,700 |
| (c) Manitoba | | - | - | - |
| | Total | - | 39,700 | 39,700 |
| 10. Import Duties | | | | |
| (a) Alberta | | 345,364 | 28,986 | 374,350 |
| (b) Saskatchewan | | 826,751 | 1,025,574 | 1,852,325 |
| (c) Manitoba | | - | 514,550 | 514,550 |
| | Total | 1,172,115 | 1,569,110 | 2,741,225 |

| A. Materials (Continued) | | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|---|
| 11. Dominion Sales Tax | | | | |
| (a) Alberta | | $ 664,944 | $ 758,239 | $ 1,423,183 |
| (b) Saskatchewan | | 1,276,028 | 1,579,425 | 2,855,453 |
| (c) Manitoba | | - | 789,908 | 789,908 |
| | Total | 1,940,972 | 3,127,572 | 5,068,544 |
| 12. Provincial Tax | | | | |
| (a) Alberta | | - | - | - |
| (b) Saskatchewan | | 480,585 | 595,649 | 1,076,234 |
| (c) Manitoba | | - | - | - |
| | Total | 480,585 | 595,649 | 1,076,234 |
| 13. Miscellaneous Materials | | | | |
| (a) Alberta | | 87,329 | 97,131 | 184,460 |
| (b) Saskatchewan | | 167,168 | 206,983 | 374,151 |
| (c) Manitoba | | - | 99,715 | 99,715 |
| | Total | 254,497 | 403,829 | 658,326 |
| 14. Total Material Cost - Western Section | | | | |
| (a) Alberta | | 8,873,000 | 9,853,000 | 18,726,000 |
| (b) Saskatchewan | | 16,872,000 | 20,906,000 | 37,778,000 |
| (c) Manitoba | | - | 10,025,000 | 10,025,000 |
| | Total | 25,745,000 | 40,784,000 | 66,529,000 |

| B. Installation - Western Section | | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|---|
| 1. Pipeline | | | | |
| (a) Alberta | | $ 2,468,943 | $ 2,733,595 | $ 5,202,538 |
| (b) Saskatchewan | | 4,829,092 | 5,772,411 | 10,601,503 |
| (c) Manitoba | | - | 2,882,633 | 2,882,633 |
| | Total | 7,298,035 | 11,388,639 | 18,686,674 |
| 2. River and Stream Crossings | | | | |
| (a) Alberta | | 85,000 | - | 85,000 |
| (b) Saskatchewan | | - | 750,000 | 750,000 |
| (c) Manitoba | | - | - | - |
| | Total | 85,000 | 750,000 | 835,000 |
| 3. Highway and Railway Crossings | | | | |
| (a) Alberta | | 30,050 | 59,200 | 89,250 |
| (b) Saskatchewan | | 100,000 | 148,750 | 248,750 |
| (c) Manitoba | | - | 85,000 | 85,000 |
| | Total | 130,050 | 292,950 | 423,000 |
| 4. Valve Assemblies | | | | |
| (a) Alberta | | 10,000 | 14,000 | 24,000 |
| (b) Saskatchewan | | 24,500 | 28,000 | 52,500 |
| (c) Manitoba | | - | 14,000 | 14,000 |
| | Total | 34,500 | 56,000 | 90,500 |
| 5. Scraper Traps | | | | |
| (a) Alberta | | 10,500 | 14,000 | 24,500 |
| (b) Saskatchewan | | 30,000 | 45,000 | 75,000 |
| (c) Manitoba | | - | 22,500 | 22,500 |
| | Total | 40,500 | 81,500 | 122,000 |

| | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| B. Installation (Continued) | | | |
| 6. Testing and Miscellaneous Construction | | | |
| (a) Alberta | $ 129,507 | $ 140,205 | $ 269,712 |
| (b) Saskatchewan | 249,408 | 336,839 | 586,247 |
| (c) Manitoba | - | 150,867 | 150,867 |
| Total | 378,915 | 627,911 | 1,006,826 |
| 7. Total Installation Cost - Western Section | | | |
| (a) Alberta | 2,734,000 | 2,961,000 | 5,695,000 |
| (b) Saskatchewan | 5,233,000 | 7,081,000 | 12,314,000 |
| (c) Manitoba | - | 3,155,000 | 3,155,000 |
| Total | 7,967,000 | 13,197,000 | 21,164,000 |
| 8. Total Direct Pipeline Cost - Western Section | | | |
| (a) Alberta | 11,607,000 | 12,814,000 | 24,421,000 |
| (b) Saskatchewan | 22,105,000 | 27,987,000 | 50,092,000 |
| (c) Manitoba | - | 13,180,000 | 13,180,000 |
| Total - Western Section | 33,712,000 | 53,981,000 | 87,693,000 |

c. Details - Central Section, Pipeline

| A. Materials - Central Section | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| 1. Right-of-Way Easements and Damages | | | |
| (a) North Dakota | $ - | $ 191,750 | $ 191,750 |
| (b) Minnesota | 235,600 | 145,400 | 381,000 |
| (c) Wisconsin | - | 146,200 | 146,200 |
| (d) Michigan | 181,700 | 276,400 | 458,100 |
| Total | 417,300 | 759,750 | 1,177,050 |
| 2. Pipe | | | |
| (a) North Dakota | - | 5,637,555 | 5,637,555 |
| (b) Minnesota | 8,825,102 | 5,408,884 | 14,233,986 |
| (c) Wisconsin | - | 5,889,936 | 5,889,936 |
| (d) Michigan | 5,965,149 | 10,236,642 | 16,201,791 |
| Total | 14,790,251 | 27,173,017 | 41,963,268 |
| 3. Pipe Freight | | | |
| (a) North Dakota | - | 681,778 | 681,778 |
| (b) Minnesota | 920,480 | 564,160 | 1,484,640 |
| (c) Wisconsin | - | 624,000 | 624,000 |
| (d) Michigan | 497,520 | 851,280 | 1,348,800 |
| Total | 1,418,000 | 2,721,218 | 4,139,218 |
| 4. Highway and Railway Crossings | | | |
| (a) North Dakota | - | 25,057 | 25,057 |
| (b) Minnesota | 45,469 | 22,125 | 67,594 |
| (c) Wisconsin | - | 39,281 | 39,281 |
| (d) Michigan | 27,960 | 67,066 | 95,026 |
| Total | 73,429 | 153,529 | 226,958 |

| | | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|---|
| A. Materials (Continued) | | | | |
| 5. Coating Materials | | | | |
| (a) North Dakota | | $ - | $ 329,308 | $ 329,308 |
| (b) Minnesota | | 502,653 | 310,083 | 812,736 |
| (c) Wisconsin | | - | 311,801 | 311,801 |
| (d) Michigan | | 340,597 | 590,021 | 930,618 |
| | Total | 843,250 | 1,541,213 | 2,384,463 |
| 6. Concrete Weights | | | | |
| (a) North Dakota | | - | 30,000 | 30,000 |
| (b) Minnesota | | 180,000 | 90,000 | 270,000 |
| (c) Wisconsin | | - | 90,000 | 90,000 |
| (d) Michigan | | 315,000 | 240,000 | 555,000 |
| | Total | 495,000 | 450,000 | 945,000 |
| 7. Main Line Valve Assemblies | | | | |
| (a) North Dakota | | - | 47,790 | 47,790 |
| (b) Minnesota | | 95,580 | 63,720 | 159,300 |
| (c) Wisconsin | | - | 47,790 | 47,790 |
| (d) Michigan | | 47,790 | 111,510 | 159,300 |
| | Total | 143,370 | 270,810 | 414,180 |
| 8. Scraper Traps | | | | |
| (a) North Dakota | | - | 116,400 | 116,400 |
| (b) Minnesota | | 155,200 | 77,600 | 232,800 |
| (c) Wisconsin | | - | 77,600 | 77,600 |
| (d) Michigan | | 155,200 | 155,200 | 310,400 |
| | Total | 310,400 | 426,800 | 737,200 |
| 9. Lake Crossing Manifolds | | | | |
| (a) Michigan | | 79,400 | - | 79,400 |
| | Total | 79,400 | - | 79,400 |

| | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| A. Materials (Continued) | | | |
| 10. State Taxes | | | |
| (a) North Dakota | $ - | $ 137,358 | $ 137,358 |
| (b) Minnesota | - | - | - |
| (c) Wisconsin | - | - | - |
| (d) Michigan | 222,858 | 367,552 | 590,410 |
| Total | 222,858 | 504,910 | 727,768 |
| 11. Miscellaneous Material | | | |
| (a) North Dakota | - | 72,004 | 72,004 |
| (b) Minnesota | 109,916 | 67,028 | 176,944 |
| (c) Wisconsin | - | 72,392 | 72,392 |
| (d) Michigan | 78,826 | 128,329 | 207,155 |
| Total | 188,742 | 339,753 | 528,495 |
| 12. Total Material Cost - Central Section | | | |
| (a) North Dakota | - | 7,269,000 | 7,269,000 |
| (b) Minnesota | 11,070,000 | 6,749,000 | 17,819,000 |
| (c) Wisconsin | - | 7,299,000 | 7,299,000 |
| (d) Michigan | 7,912,000 | 13,024,000 | 20,936,000 |
| Total | 18,982,000 | 34,341,000 | 53,323,000 |

| | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| **B. Installation - Central Section** | | | |
| 1. Pipeline | | | |
| (a) North Dakota | $ - | $ 2,768,290 | $ 2,768,290 |
| (b) Minnesota | 4,884,334 | 2,999,040 | 7,883,374 |
| (c) Wisconsin | - | 3,279,108 | 3,279,108 |
| (d) Michigan | 3,910,599 | 7,293,264 | 11,203,863 |
| Total | 8,794,933 | 16,339,702 | 25,134,635 |
| 2. River and Stream Crossings | | | |
| (a) Michigan | 1,750,000 | - | 1,750,000 |
| Total | 1,750,000 | - | 1,750,000 |
| 3. Highway and Railway Crossings | | | |
| (a) North Dakota | - | 55,000 | 55,000 |
| (b) Minnesota | 103,250 | 50,000 | 153,250 |
| (c) Wisconsin | - | 88,750 | 88,750 |
| (d) Michigan | 63,750 | 155,750 | 219,500 |
| Total | 167,000 | 349,500 | 516,500 |
| 4. Valve Assemblies | | | |
| (a) North Dakota | - | 10,500 | 10,500 |
| (b) Minnesota | 21,000 | 14,000 | 35,000 |
| (c) Wisconsin | - | 10,500 | 10,500 |
| (d) Michigan | 10,500 | 24,500 | 35,000 |
| Total | 31,500 | 59,500 | 91,000 |
| 5. Scraper Traps | | | |
| (a) North Dakota | - | 22,500 | 22,500 |
| (b) Minnesota | 30,000 | 15,000 | 45,000 |
| (c) Wisconsin | - | 15,000 | 15,000 |
| (d) Michigan | 30,000 | 30,000 | 60,000 |
| Total | 60,000 | 82,500 | 142,500 |

| | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| B. Installation (Continued) | | | |
| 6. Testing and Miscellaneous Construction | | | |
| (a) North Dakota | $ - | $ 142,710 | $ 142,710 |
| (b) Minnesota | 251,416 | 153,960 | 405,376 |
| (c) Wisconsin | - | 169,642 | 169,642 |
| (d) Michigan | 288,151 | 375,486 | 663,637 |
| Total | 539,567 | 841,798 | 1,381,365 |
| 7. Total Installation Cost - Central Section | | | |
| (a) North Dakota | - | 2,999,000 | 2,999,000 |
| (b) Minnesota | 5,290,000 | 3,232,000 | 8,522,000 |
| (c) Wisconsin | - | 3,563,000 | 3,563,000 |
| (d) Michigan | 6,053,000 | 7,879,000 | 13,932,000 |
| Total | 11,343,000 | 17,673,000 | 29,016,000 |
| 8. Total Direct Pipeline Cost - Central Section | | | |
| (a) North Dakota | - | 10,268,000 | 10,268,000 |
| (b) Minnesota | 16,360,000 | 9,981,000 | 26,341,000 |
| (c) Wisconsin | - | 10,862,000 | 10,862,000 |
| (d) Michigan | 13,965,000 | 20,903,000 | 34,868,000 |
| Total - Central Section | 30,325,000 | 52,014,000 | 82,339,000 |

d. Details - Eastern Section, Pipeline

| | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| **A. Materials - Eastern Section** | | | |
| 1. Right-of-Way Easements and Damages | | | |
| (a) Ontario | $ 207,000 | $ 345,600 | $ 552,600 |
| (b) Quebec | 309,000 | 100,000 | 409,000 |
| Total | 516,000 | 445,600 | 961,600 |
| 2. Pipe | | | |
| (a) Ontario | 10,989,927 | 18,316,682 | 29,306,609 |
| (b) Quebec | 2,323,244 | 68,931 | 2,392,175 |
| Total | 13,313,171 | 18,385,613 | 31,698,784 |
| 3. Pipe Freight | | | |
| (a) Ontario | 813,832 | 1,356,396 | 2,170,228 |
| (b) Quebec | 183,414 | 2,979 | 186,393 |
| Total | 997,246 | 1,359,375 | 2,356,621 |
| 4. Highway and Railway Crossings | | | |
| (a) Ontario | 89,675 | 171,680 | 261,355 |
| (b) Quebec | 67,950 | - | 67,950 |
| Total | 157,625 | 171,680 | 329,305 |
| 5. Coating Materials | | | |
| (a) Ontario | 564,256 | 940,776 | 1,505,032 |
| (b) Quebec | 127,620 | 2,975 | 130,595 |
| Total | 691,876 | 943,751 | 1,635,627 |
| 6. Concrete Weights | | | |
| (a) Ontario | 67,500 | 127,500 | 195,000 |
| (b) Quebec | 30,000 | 75,000 | 105,000 |
| Total | 97,500 | 202,500 | 300,000 |

| | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| A. Materials (Continued) | | | |
| 7. MainLine Valve Assemblies | | | |
| (a) Ontario | $ 95,580 | $ 175,230 | $ 270,810 |
| (b) Quebec | 15,930 | - | 15,930 |
| Total | 111,510 | 175,230 | 286,740 |
| 8. Scraper Traps | | | |
| (a) Ontario | 155,200 | 232,800 | 388,000 |
| (b) Quebec | 116,400 | - | 116,400 |
| Total | 271,600 | 232,800 | 504,400 |
| 9. River Crossing Manifolds | | | |
| (b) Quebec | - | 39,700 | 39,700 |
| Total | - | 39,700 | 39,700 |
| 10. Import Duties | | | |
| (a) Ontario | 829,325 | 1,384,082 | 2,213,407 |
| (b) Quebec | 196,309 | 7,000 | 203,309 |
| Total | 1,025,634 | 1,391,082 | 2,416,716 |
| 11. Dominion Sales Tax | | | |
| (a) Ontario | 1,241,307 | 2,106,643 | 3,347,950 |
| (b) Quebec | 281,839 | 11,865 | 293,704 |
| Total | 1,523,146 | 2,118,508 | 3,641,654 |
| 12. Provincial Tax | | | |
| (a) Ontario | - | - | - |
| (b) Quebec | 66,854 | 4,169 | 71,023 |
| Total | 66,854 | 4,169 | 71,023 |

| | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| A. Materials (Continued) | | | |
| 13. Miscellaneous Materials | | | |
| (a) Ontario | $ 150,398 | $ 251,611 | $ 402,009 |
| (b) Quebec | 37,440 | 3,381 | 40,821 |
| Total | 187,838 | 254,992 | 442,830 |
| 14. Total Material Costs - Eastern Section | | | |
| (a) Ontario | 15,204,000 | 25,409,000 | 40,613,000 |
| (b) Quebec | 3,756,000 | 316,000 | 4,072,000 |
| Total - Eastern Section | 18,960,000 | 25,725,000 | 44,685,000 |

| B. Installation - Eastern Section | 1958 PROGRAM Total Cost | 1959 PROGRAM Total Cost | Grand Totals |
|---|---|---|---|
| 1. Pipelines | | | |
| (a) Ontario | $13,181,056 | $20,072,400 | $33,253,456 |
| (b) Quebec | 2,006,136 | - | 2,006,136 |
| Total | 15,187,192 | 20,072,400 | 35,259,592 |
| 2. River and Stream Crossings | | | |
| (a) Ontario | 200,000 | 400,000 | 600,000 |
| (b) Quebec | 50,000 | 1,500,000 | 1,550,000 |
| Total | 250,000 | 1,900,000 | 2,150,000 |
| 3. Highway and Railway Crossings | | | |
| (a) Ontario | 197,500 | 379,750 | 577,250 |
| (b) Quebec | 150,000 | - | 150,000 |
| Total | 347,500 | 379,750 | 727,250 |
| 4. Valve Assemblies | | | |
| (a) Ontario | 21,000 | 38,500 | 59,500 |
| (b) Quebec | 3,500 | - | 3,500 |
| Total | 24,500 | 38,500 | 63,000 |
| 5. Scraper Traps | | | |
| (a) Ontario | 30,000 | 45,000 | 75,000 |
| (b) Quebec | 22,500 | - | 22,500 |
| Total | 52,500 | 45,000 | 97,500 |
| 6. Testing and Miscellaneous Construction | | | |
| (a) Ontario | 681,444 | 1,107,006 | 1,788,450 |
| (b) Quebec | 111,864 | 75,000 | 186,864 |
| Total | 793,308 | 1,182,006 | 1,975,314 |

| | 1958 PROGRAM<br>Total Cost | 1959 PROGRAM<br>Total Cost | Grand Totals |
|---|---|---|---|
| B. Installation (Continued) | | | |
| 7. Total Installation Cost | | | |
| (a) Ontario | $14,311,000 | $21,982,000 | $36,293,000 |
| (b) Quebec | 2,344,000 | 1,575,000 | 3,919,000 |
| Total | 16,655,000 | 23,557,000 | 40,212,000 |
| 8. Total Direct Pipeline Cost - Eastern Section | | | |
| (a) Ontario | 29,515,000 | 47,391,000 | 76,906,000 |
| (b) Quebec | 6,100,000 | 1,891,000 | 7,991,000 |
| Total - Eastern Section | 35,615,000 | 49,282,000 | 84,897,000 |

## 5. PUMP STATION AND TANKAGE COSTS

Description of Items Listed In Investment Cost for Stations

LAND IN FEE

STORAGE TANKS -- Standard A. P. I. welded steel tanks, erected complete with standard fittings. Includes foundations, grading, firewalls and firewall drains.

MAIN LINE & BOOSTER PUMPING UNITS -- Includes complete units installed, foundations and cooling water systems.

MAIN STATION PIPING & EQUIPMENT -- Includes pipe, valves, fittings, control valves, strainers, foundations and catwalks.

AUXILIARY STATION PIPING & EQUIPMENT -- For fuel systems, air systems, oil drain systems, fire fighting equipment, and miscellaneous. Includes pipe, valves, fittings, pumps, compressors, air dryers, centrifuges, foundations, fuel tanks with firewalls, portable boiler and heating coils, sump tank, fire fighting equipment and miscellaneous equipment.

METERING FACILITIES -- Includes meters, pipe, valves, fittings, strainers, provers, pumps, foundations, shelters and catwalks.

ELECTRICAL SYSTEM, INSTRUMENTS AND CONTROLS -- (Source of power indicated on summaries) Includes generators (if required), switchgear, circuit panels, yard lighting, grounding, distribution, control console, recording and indicating instruments and alarms.

BUILDINGS -- Pumps and office buildings, includes foundations, superstructure, lighting, plumbing and fixtures, heating system, boiler and miscellaneous furniture.

STATION SITE DEVELOPMENT -- Includes station roads, access roads (where required), sidewalks, station grading, perimeter fence, water supply system (well, if required) and sewage disposal system.

STAFF HOUSING

## SUMMARY OF INVESTMENT COSTS - STATIONS
(In Thousands of Dollars)

### 30" LINE - SOUTH ROUTE

| Stations | 1960 | 1962 | 1963 | 1964 | 1965 | 1967 | 1968 | Total | Material | Construc-tion | Omission & Contingencies | Engineering & Management |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edmonton | 4203 | 389 | | | 1322 | 330 | | 6244 | 3417 | 1889 | 530 | 408 |
| Calgary | 415 | | 86 | | 70 | | | 571 | 279 | 207 | 48 | 37 |
| Britamoil | 1222 | | 16 | 191 | 9 | | | 1438 | 789 | 433 | 122 | 94 |
| Bellshill Lake | 5775 | | 66 | 10 | 1787 | | 337 | 7975 | 4147 | 2627 | 679 | 522 |
| 9 Intermediate | 5278* | | 6598* | | 3156 | | 3019 | 18051 | 11142 | 4194 | 1533 | 1182 |
| Montreal | 569 | | 33 | | 33 | | | 635 | 336 | 204 | 54 | 41 |
| TOTAL INVESTMENT (CANADA) | 17462 | 389 | 6799 | 201 | 6377 | 330 | 3356 | 34914 | 20110 | 9554 | 2966 | 2284 |
| 6 Intermediate | 3528** | | 3528** | | 1879 | | 1779 | 10714 | 6564 | 2538 | 911 | 701 |
| TOTAL INVESTMENT (U.S.) | 3528 | | 3528 | | 1879 | | 1779 | 10714 | 6564 | 2538 | 911 | 701 |
| TOTAL INVESTMENT | 20990 | 389 | 10327 | 201 | 8256 | 330 | 5135 | 45628 | 26674 | 12092 | 3877 | 2985 |

* Canada 1960 - 4 Stations
1963 - 5 Stations
** U.S. 1960 - 3 Stations
1963 - 3 Stations

## SUMMARY OF INVESTMENT COSTS - STATIONS
(In Thousands of Dollars)

### 30" LINE - NORTH ROUTE

| Stations | 1960 | 1962 | 1963 | 1964 | 1965 | 1967 | 1968 | Total | Material | Construc-tion | Omission & Contingencies | Engineering & Management |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edmonton | 4203 | 389 | | | 1322 | 330 | | 6244 | 3417 | 1889 | 530 | 408 |
| Calgary | 415 | | 86 | | 70 | | | 571 | 279 | 207 | 48 | 37 |
| Britamoil Jct. | 1222 | | 16 | 191 | 9 | | | 1438 | 789 | 433 | 122 | 94 |
| Bellshill Lake | 5775 | | 66 | 10 | 1787 | | 337 | 7975 | 4147 | 2627 | 679 | 522 |
| 17 Intermediate | 10556* | | 11875* | | 5962 | | 5702 | 34095 | 21046 | 7922 | 2896 | 2231 |
| Montreal | 569 | | 33 | | 33 | | | 635 | 336 | 204 | 54 | 41 |
| TOTAL INVESTMENT (CANADA) | 22740 | 389 | 12076 | 201 | 9183 | 330 | 6039 | 50958 | 30014 | 13282 | 4329 | 3333 |

* 1960 - 8 Stations
1963 - 9 Stations

SUMMARY 30" NORTH

## SUMMARY OF INVESTMENT COSTS - STATIONS
(In Thousands of Dollars)

### 34" LINE - SOUTH ROUTE

| Stations | 1960 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | Total | Material | Construction | Omission & Contingencies | Engineering & Management |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edmonton | 4203 | 389 | | | 1322 | | 330 | 6244 | 3417 | 1889 | 530 | 408 |
| Calgary | 415 | | 86 | | 70 | | | 571 | 279 | 207 | 48 | 37 |
| Britamoil | 1222 | | 16 | 191 | 9 | | | 1438 | 789 | 433 | 122 | 94 |
| Bellshill Lake | 5775 | | 66 | 10 | 1437 | 337 | | 7625 | 3914 | 2563 | 649 | 499 |
| 5 Intermediate | 2768* | | | 4153* | | 1671 | | 8592 | 5190 | 2110 | 730 | 562 |
| Montreal | 569 | | 33 | | 33 | | | 635 | 336 | 204 | 54 | 41 |
| TOTAL INVESTMENT (CANADA) | 14952 | 389 | 201 | 4354 | 2871 | 2008 | 330 | 25105 | 13925 | 7406 | 2133 | 1641 |
| 4 Intermediate | 2481** | | | 2481** | | 1181 | | 6143 | 3684 | 1536 | 521 | 402 |
| TOTAL INVESTMENT (U. S.) | 2481 | | | 2481 | | 1181 | | 6143 | 3684 | 1536 | 521 | 402 |
| TOTAL INVESTMENT | 17433 | 389 | 201 | 6835 | 2871 | 3189 | 330 | 31248 | 17609 | 8942 | 2654 | 2043 |

* Canada 1960 - 2 Stations
1964 - 3 Stations

** U.S. 1960 - 2 Stations
1964 - 2 Stations

SUMMARY 34" SOUTH

## SUMMARY OF INVESTMENT COSTS - STATIONS
(In Thousands of Dollars)

### 34" LINE - NORTH ROUTE

| Stations | 1960 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | Total | Material | Construc-tion | Omission & Contingencies | Engineering & Management |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edmonton | 4203 | 389 | | | 1322 | | 330 | 6244 | 3417 | 1889 | 530 | 408 |
| Calgary | 415 | | 86 | | 70 | | | 571 | 279 | 207 | 48 | 37 |
| Britamoil Jct. | 1222 | | 16 | 191 | 9 | | | 1438 | 789 | 433 | 122 | 94 |
| Bellshill Lake | 5775 | | 66 | 10 | 1437 | 337 | | 7625 | 3914 | 2563 | 649 | 499 |
| 11 Intermediate | 6921* | | | 8306* | | 3677 | | 18904 | 11418 | 4642 | 1606 | 1238 |
| Montreal | 569 | | 33 | | 33 | | | 635 | 336 | 204 | 54 | 41 |
| TOTAL INVESTMENT (CANADA) | 19105 | 389 | 201 | 8507 | 2871 | 4014 | 330 | 35417 | 20153 | 9938 | 3009 | 2317 |

* 1960 - 5 Stations
1964 - 6 Stations

APPLIES TO:
30" Line - South Route
34" Line - South Route
30" Line - North Route
34" Line - North Route

## EDMONTON STATION
## INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

| ITEM | 1960 Matl | 1960 Const | 1962 Matl | 1962 Const | 1965 Matl | 1965 Const | 1967 Matl | 1967 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|---|---|---|---|
| Land in Fee | 50 | | | | | | | | 50 | |
| Storage Tanks | | | | | | | | | | |
| 100,000 Bbl. | 915 | 551 | | | | | | | 915 | 551 |
| 100,000 Bbl. | | | | | 343 | 268 | | | 343 | 268 |
| Main Line & Booster Pumping Units | 346 | 40 | 194 | 29 | 183 | 27 | 183 | 27 | 906 | 123 |
| Main Station Piping & Equipment | 629 | 415 | 52 | 32 | 149 | 95 | 37 | 20 | 867 | 562 |
| Auxiliary Station Piping & Equipment | 42 | 25 | 1 | 2 | 2 | 4 | 2 | 4 | 47 | 35 |
| Electrical System, Instruments & Controls (Public Power) | 153 | 217 | 6 | 9 | 10 | 12 | 3 | 4 | 172 | 242 |
| Station Buildings | 78 | 63 | 1 | 5 | 14 | 17 | | | 93 | 85 |
| Station Site Development | 24 | 23 | | | | | | | 24 | 23 |
| Sub Totals | 2237 | 1334 | 254 | 77 | 701 | 423 | 225 | 55 | 3417 | 1889 |
| Total Material & Construction | 3571 | | 331 | | 1124 | | 280 | | 5306 | |
| Omissions & Contingencies | 357 | | 33 | | 112 | | 28 | | 530 | |
| Engineering & Management | 275 | | 25 | | 86 | | 22 | | 408 | |
| TOTAL INVESTMENT (CANADA) | 4203 | | 389 | | 1322 | | 330 | | 6244 | |

EDMONTON

APPLIES TO:
30" Line - South Route
34" Line - South Route
30" Line - North Route
34" Line - North Route

## CALGARY STATION
## INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

| ITEM | 1960 Matl | 1960 Const | 1963 Matl | 1963 Const | 1965 Matl | 1965 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|---|---|
| Land in Fee | 20 | | | | | | 20 | |
| Storage Tanks 50,000 Bbl. | 60 | 63 | | | | | 60 | 63 |
| Main Line & Booster Pumping Units | 2 | 1 | 15 | 3 | 17 | 4 | 34 | 8 |
| Main Station Piping & Equipment | 18 | 12 | 13 | 7 | 13 | 7 | 44 | 26 |
| Auxiliary Station Piping & Equipment | 3 | 5 | | | | | 3 | 5 |
| Metering Facilities | 19 | 13 | | | 2 | 1 | 21 | 14 |
| Electrical System, Instruments & Controls (Public Power) | 42 | 34 | 4 | 5 | 5 | 7 | 51 | 46 |
| Station Buildings | 23 | 24 | 15 | 12 | 1 | 2 | 39 | 38 |
| Station Site Development | 7 | 7 | | | | | 7 | 7 |
| Sub Totals | 194 | 159 | 47 | 27 | 38 | 21 | 279 | 207 |
| Total Material & Construction | 353 | | 74 | | 59 | | 486 | |
| Omissions & Contingencies | 35 | | 7 | | 6 | | 48 | |
| Engineering & Management | 27 | | 5 | | 5 | | 37 | |
| TOTAL INVESTMENT (CANADA) | 415 | | 86 | | 70 | | 571 | |

CALGARY

APPLIES TO:
30" Line - South Route
34" Line - South Route
30" Line - North Route
34" Line - North Route

## BRITAMOIL STATION
## INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

| ITEM | 1960 Matl | 1960 Const | 1963 Matl | 1963 Const | 1964 Matl | 1964 Const | 1965 Matl | 1965 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|---|---|---|---|
| Land in Fee | 20 | | | | | | | | 20 | |
| Storage Tanks: 30,000 Bbl. | 41 | 45 | | | | | | | 41 | 45 |
| Main Line & Booster Pumping Units | 213 | 40 | 2 | 1 | 101 | 19 | | | 316 | 60 |
| Main Station Piping & Equipment | 90 | 54 | 2 | 2 | 19 | 10 | | | 111 | 66 |
| Auxiliary Station Piping & Equipment | 41 | 25 | | | 1 | 2 | | | 42 | 27 |
| Metering Facilities | 58 | 35 | | | | | 3 | 2 | 61 | 37 |
| Electrical System, Instruments & Controls (Station Generators) | 37 | 35 | 4 | 3 | 3 | 2 | 1 | 1 | 45 | 41 |
| Station Buildings | 78 | 62 | | | 1 | 5 | | | 79 | 67 |
| Station Site Development | 24 | 40 | | | | | | | 24 | 40 |
| Staff Housing | 50 | 50 | | | | | | | 50 | 50 |
| Sub Totals | 652 | 386 | 8 | 6 | 125 | 38 | 4 | 3 | 789 | 433 |
| Total Material & Construction | 1038 | | 14 | | 163 | | 7 | | 1222 | |
| Omissions & Contingencies | 104 | | 1 | | 16 | | 1 | | 122 | |
| Engineering & Management | 80 | | 1 | | 12 | | 1 | | 94 | |
| TOTAL INVESTMENT (CANADA) | 1222 | | 16 | | 191 | | 9 | | 1438 | |

BRITAMOIL

BELLSHILL STATION
INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

APPLIES TO:
30" Line - South Route
30" Line - North Route

| ITEM | 1960 Matl | 1960 Const | 1963 Matl | 1963 Const | 1964 Matl | 1964 Const | 1965 Matl | 1965 Const | 1968 Matl | 1968 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land in Fee | 50 | | | | | | | | | | 50 | |
| Storage Tanks: | | | | | | | | | | | | |
| 150,000 Bbl. | 685 | 458 | | | | | 343 | 229 | | | 1028 | 687 |
| 96,000 Bbl. | 219 | 169 | | | | | 146 | 84 | | | 365 | 253 |
| 42,500 Bbl. | 106 | 105 | | | | | 53 | 53 | | | 159 | 158 |
| Main Line & Booster Pumping Units | 426 | 59 | 12 | 2 | | | 183 | 27 | 183 | 27 | 804 | 115 |
| Main Station Piping & Equipment | 926 | 712 | 10 | 8 | | | 212 | 130 | 39 | 22 | 1187 | 872 |
| Auxiliary Station Piping & Equipment | 43 | 30 | | | | | 1 | 2 | 1 | 2 | 45 | 34 |
| Metering Facilities | 149 | 88 | 11 | 7 | 5 | 3 | 12 | 7 | | | 177 | 105 |
| Electrical System, Instrument & Controls (Public Power) | 153 | 217 | 3 | 3 | | | 9 | 12 | 3 | 3 | 168 | 235 |
| Station Buildings | 77 | 61 | | | | | 7 | 8 | 1 | 5 | 85 | 74 |
| Station Site Development | 29 | 44 | | | | | | | | | 29 | 44 |
| Staff Housing | 50 | 50 | | | | | | | | | 50 | 50 |
| Sub Totals | 2913 | 1993 | 36 | 20 | 5 | 3 | 966 | 552 | 227 | 59 | 4147 | 2627 |
| Total Material & Construction | 4906 | | 56 | | 8 | | 1518 | | 286 | | 6774 | |
| Omissions & Contingencies | 491 | | 6 | | 1 | | 152 | | 29 | | 679 | |
| Engineering & Management | 378 | | 4 | | 1 | | 117 | | 22 | | 522 | |
| TOTAL INVESTMENT (CANADA) | 5775 | | 66 | | 10 | | 1787 | | 337 | | 7975 | |

BELLSHILL

## BELLSHILL STATION
## INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

APPLIES TO:
34" Line - South Route
34" Line - North Route

| ITEM | 1960 Matl | 1960 Const | 1963 Matl | 1963 Const | 1964 Matl | 1964 Const | 1965 Matl | 1965 Const | 1966 Matl | 1966 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Land in Fee | 50 | | | | | | | | | | 50 | |
| Storage Tanks: | | | | | | | | | | | | |
| 150,000 Bbl. | 685 | 458 | | | | | 343 | 229 | | | 1028 | 687 |
| 96,000 Bbl. | 219 | 169 | | | | | 146 | 84 | | | 365 | 253 |
| 42,500 Bbl. | 106 | 105 | | | | | 53 | 53 | | | 159 | 158 |
| Main Line & Booster Pumping Units | 426 | 59 | 12 | 2 | | | | | 183 | 27 | 621 | 88 |
| Main Station Piping & Equipment | 926 | 712 | 10 | 8 | | | 173 | 108 | 39 | 22 | 1148 | 850 |
| Auxiliary Station Piping & Equipment | 43 | 30 | | | | | | | 1 | 2 | 44 | 32 |
| Metering Facilities | 149 | 88 | 11 | 7 | 5 | 3 | 12 | 7 | | | 177 | 105 |
| Electrical System, Instrument & Controls (Station Generators) | 153 | 217 | 3 | 3 | | | 6 | 7 | 3 | 3 | 165 | 230 |
| Station Buildings | 77 | 61 | | | | | | | 1 | 5 | 78 | 66 |
| Station Site Development | 29 | 44 | | | | | | | | | 29 | 44 |
| Staff Housing | 50 | 50 | | | | | | | | | 50 | 50 |
| Sub Totals | 2913 | 1993 | 36 | 20 | 5 | 3 | 733 | 488 | 227 | 59 | 3914 | 2563 |
| Total Material & Construction | 4906 | | 56 | | 8 | | 1221 | | 286 | | 6477 | |
| Omissions & Contingencies | 491 | | 6 | | 1 | | 122 | | 29 | | 649 | |
| Engineering & Management | 378 | | 4 | | 1 | | 94 | | 22 | | 499 | |
| TOTAL INVESTMENT (CANADA) | 5775 | | 66 | | 10 | | 1437 | | 337 | | 7625 | |

BELLSHILL

## TYPICAL INTERMEDIATE STATION INVESTMENT COSTS (UNITED STATES)
(Thousands of Dollars)

APPLIES TO:
30" Line - South Route

| ITEM | 1960 or 1963 Matl | 1960 or 1963 Const | 1965 Matl | 1965 Const | 1968 Matl | 1968 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|---|---|
| Land in Fee | 10 | | | | | | 10 | |
| Main Line & Booster Pumping Units | 332 | 44 | 167 | 25 | 167 | 25 | 666 | 94 |
| Main Station Piping & Equipment | 152 | 89 | 33 | 19 | 33 | 19 | 218 | 127 |
| Auxiliary Station Piping & Equipment | 4 | 7 | 1 | 2 | 1 | 2 | 6 | 11 |
| Electrical System, Instruments & Controls (Station Generators) | 33 | 27 | 2 | 2 | 2 | 3 | 37 | 32 |
| Station Buildings | 77 | 62 | 7 | 8 | | | 84 | 70 |
| Station Site Development | 23 | 39 | | | | | 23 | 39 |
| Staff Housing | 50 | 50 | | | | | 50 | 50 |
| Sub Totals | 681 | 318 | 210 | 56 | 203 | 49 | 1094 | 423 |
| Total Material & Construction | 999 | | 266 | | 252 | | 1517 | |
| Omissions & Contingencies | 100 | | 27 | | 25 | | 152 | |
| Engineering & Management | 77 | | 20 | | 19 | | 116 | |
| TOTAL INVESTMENT (UNITED STATES) | 1176 | | 313 | | 296 | | 1785 | |

TYPICAL INTERMEDIATE

## TYPICAL INTERMEDIATE STATION INVESTMENT COSTS (CANADA)

(Thousands of Dollars)

APPLIES TO:
30" Line - South Route
30" Line - North Route

| ITEM | 1960 or 1963 | | 1965 | | 1968 | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Matl | Const | Matl | Const | Matl | Const | Matl | Const |
| Land in Fee | 10 | | | | | | 10 | |
| Main Line & Booster Pumping Units | 362 | 48 | 183 | 27 | 183 | 27 | 728 | 102 |
| Main Station Piping & Equipment | 203 | 117 | 44 | 22 | 44 | 23 | 291 | 162 |
| Auxiliary Station Piping & Equipment | 4 | 7 | 1 | 2 | 1 | 2 | 6 | 11 |
| Electrical System, Instruments & Controls (Station Generators) | 42 | 27 | 2 | 2 | 2 | 3 | 46 | 32 |
| Station Buildings | 77 | 62 | 7 | 8 | | | 84 | 70 |
| Station Site Development | 23 | 39 | | | | | 23 | 39 |
| Staff Housing | 50 | 50 | | | | | 50 | 50 |
| Sub Totals | 771 | 350 | 237 | 61 | 230 | 55 | 1238 | 466 |
| Total Material & Construction | 1121 | | 298 | | 285 | | 1704 | |
| Omissions & Contingencies | 112 | | 30 | | 29 | | 171 | |
| Engineering & Management | 86 | | 23 | | 22 | | 131 | |
| TOTAL INVESTMENT (CANADA) | 1319 | | 351 | | 336 | | 2006 | |

TYPICAL INTERMEDIATE

TYPICAL INTERMEDIATE STATION
INVESTMENT COSTS (UNITED STATES)
(Thousands of Dollars)

APPLIES TO:
34" Line - South Route

| ITEM | 1960 or 1964 Matl | 1960 or 1964 Const | 1966 Matl | 1966 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|
| Land in Fee | 10 | | | | 10 | |
| Main Line & Booster Pumping Units | 332 | 44 | 167 | 25 | 499 | 69 |
| Main Station Piping & Equipment | 152 | 89 | 33 | 19 | 185 | 108 |
| Auxiliary Station Piping & Equipment | 41 | 26 | 1 | 2 | 42 | 28 |
| Electrical System, Instruments & Controls (Station Generators) | 33 | 27 | 2 | 2 | 35 | 29 |
| Station Buildings | 77 | 61 | | | 77 | 61 |
| Station Site Development | 23 | 39 | | | 23 | 39 |
| Staff Housing | 50 | 50 | | | 50 | 50 |
| Sub Totals | 718 | 336 | 203 | 48 | 921 | 384 |
| Total Material & Construction | 1054 | | 251 | | 1305 | |
| Omissions & Contingencies | 105 | | 25 | | 130 | |
| Engineering & Management | 81 | | 19 | | 100 | |
| TOTAL INVESTMENT (UNITED STATES) | 1240 | | 295 | | 1535 | |

TYPICAL INTERMEDIATE

**TYPICAL INTERMEDIATE STATION**
**INVESTMENT COSTS (CANADA)**
(Thousands of Dollars)

APPLIES TO:
34" Line - South Route
34" Line - North Route

| ITEM | 1960 or 1964 Matl | 1960 or 1964 Const | 1966 Matl | 1966 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|
| Land in Fee | 10 | | | | 10 | |
| Main Line & Booster Pumping Units | 362 | 48 | 183 | 27 | 545 | 75 |
| Main Station Piping & Equipment | 203 | 117 | 44 | 23 | 247 | 140 |
| Auxiliary Station Piping & Equipment | 41 | 26 | 1 | 2 | 42 | 28 |
| Electrical System, Instruments & Controls (Station Generators) | 42 | 27 | 2 | 2 | 44 | 29 |
| Station Buildings | 77 | 61 | | | 77 | 61 |
| Station Site Development | 23 | 39 | | | 23 | 39 |
| Staff Housing | 50 | 50 | | | 50 | 50 |
| Sub Totals | 808 | 368 | 230 | 54 | 1038 | 422 |
| Total Material & Construction | 1176 | | 284 | | 1460 | |
| Omissions & Contingencies | 118 | | 28 | | 146 | |
| Engineering & Management | 90 | | 22 | | 112 | |
| TOTAL INVESTMENT (CANADA) | 1384 | | 334 | | 1718 | |

TYPICAL INTERMEDIATE

APPLIES TO:
30" Line - South Route
34" Line - South Route
30" Line - North Route
34" Line - North Route

## MONTREAL TERMINAL
## INVESTMENT COSTS (CANADA)
(Thousands of Dollars)

| ITEM | 1960 Matl | 1960 Const | 1963 Matl | 1963 Const | 1965 Matl | 1965 Const | Total Matl | Total Const |
|---|---|---|---|---|---|---|---|---|
| Land in Fee | 10 | | | | | | 10 | |
| Main Station Piping & Equipment | 51 | 28 | | | | | 51 | 28 |
| Auxiliary Station Piping & Equipment | 3 | 3 | | | | | 3 | 3 |
| Metering Facilities | 175 | 99 | 17 | 11 | 17 | 11 | 209 | 121 |
| Electrical System, Instruments & Controls (Public Power) | 31 | 19 | | | | | 31 | 19 |
| Station Buildings | 22 | 23 | | | | | 22 | 23 |
| Station Site Development | 10 | 10 | | | | | 10 | 10 |
| Sub Totals | 302 | 182 | 17 | 11 | 17 | 11 | 336 | 204 |
| Total Material & Construction | 484 | | 28 | | 28 | | 540 | |
| Omissions & Contingencies | 48 | | 3 | | 3 | | 54 | |
| Engineering & Management | 37 | | 2 | | 2 | | 41 | |
| TOTAL INVESTMENT (CANADA) | 569 | | 33 | | 33 | | 635 | |

## B. ESTIMATED ANNUAL OPERATING COSTS

### 1. SUMMARY OF ANNUAL OPERATING COSTS
### SOUTHERN ROUTE

(000 Omitted)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| **30" System** | | | | | | | | | | |
| (1) Stations, excluding labor and tankage | $1,135 | $1,578 | $2,174 | $2,819 | $3,636 | $4,487 | $5,216 | $6,003 | $6,898 | $7,707 |
| (2) Station and Terminal Labor | 792 | 792 | 792 | 1,293 | 1,293 | 1,293 | 1,293 | 1,293 | 1,293 | 1,293 |
| (3) Tank Maintenance | 70 | 70 | 70 | 70 | 70 | 100 | 100 | 100 | 100 | 100 |
| (4) Pipeline Maintenance | 989 | 989 | 989 | 989 | 989 | 989 | 989 | 989 | 989 | 989 |
| (5) Communications | 292 | 292 | 292 | 292 | 292 | 292 | 292 | 292 | 292 | 292 |
| Subtotal | 3,278 | 3,721 | 4,317 | 5,463 | 6,280 | 7,161 | 7,890 | 8,677 | 9,572 | 10,381 |
| *(6) Administration | 913 | 857 | 857 | 1,058 | 1,058 | 1,070 | 1,070 | 1,070 | 1,070 | 1,070 |
| Total | $4,191 | $4,578 | $5,174 | $6,521 | $7,338 | $8,231 | $8,960 | $9,747 | $10,642 | $11,451 |
| **34" System** | | | | | | | | | | |
| (1) Stations, excluding labor and tankage | $ 585 | $ 798 | $1,126 | $1,486 | $1,919 | $2,410 | $2,867 | $3,331 | $3,877 | $4,385 |
| (2) Station and Terminal Labor | 604 | 604 | 604 | 604 | 917 | 917 | 917 | 917 | 917 | 917 |
| (3) Tank Maintenance | 70 | 70 | 70 | 70 | 70 | 100 | 100 | 100 | 100 | 100 |
| (4) Pipeline Maintenance | 1,122 | 1,122 | 1,122 | 1,122 | 1,122 | 1,122 | 1,122 | 1,122 | 1,122 | 1,122 |
| (5) Communications | 292 | 292 | 292 | 292 | 292 | 292 | 292 | 292 | 292 | 292 |
| Subtotal | 2,673 | 2,886 | 3,214 | 3,574 | 4,320 | 4,841 | 5,298 | 5,762 | 6,308 | 6,816 |
| *(6) Administration | 835 | 835 | 835 | 835 | 960 | 972 | 972 | 972 | 972 | 972 |
| Total | $3,508 | $3,721 | $4,049 | $4,409 | $5,280 | $5,813 | $6,270 | $6,734 | $7,280 | $7,788 |

* Administration is computed as 40% of items (2), (3), (4) and (5).
Small tools, supplies, and automotive and maintenance equipment are included in station and pipeline maintenance and administration costs.

## 2. SUMMARY OF ANNUAL OPERATING COSTS
## NORTHERN ROUTE

(000 Omitted)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| 30" System | | | | | | | | | | |
| (1) Stations, excluding labor and tankage | $1,211 | $1,680 | $2,312 | $2,996 | $3,833 | $4,764 | $5,522 | $6,361 | $7,305 | $8,168 |
| (2) Station and Terminal Labor | 855 | 855 | 855 | 1,418 | 1,418 | 1,418 | 1,418 | 1,418 | 1,418 | 1,418 |
| (3) Tank Maintenance | 70 | 70 | 70 | 70 | 70 | 100 | 100 | 100 | 100 | 100 |
| (4) Pipeline Maintenance | 1,058 | 1,058 | 1,058 | 1,058 | 1,058 | 1,058 | 1,058 | 1,058 | 1,058 | 1,058 |
| (5) Communications | 455 | 455 | 455 | 455 | 455 | 455 | 455 | 455 | 455 | 455 |
| Subtotal | 3,649 | 4,118 | 4,750 | 5,997 | 6,834 | 7,795 | 8,553 | 9,392 | 10,336 | 11,199 |
| *(6) Administration | 975 | 975 | 975 | 1,200 | 1,200 | 1,212 | 1,212 | 1,212 | 1,212 | 1,212 |
| Total | $4,624 | $5,093 | $5,725 | $7,197 | $8,034 | $9,007 | $9,765 | $10,504 | $11,548 | $12,411 |
| 34" System | | | | | | | | | | |
| (1) Stations, excluding labor and tankage | $ 626 | $ 852 | $1,199 | $1,583 | $2,034 | $2,564 | $3,033 | $3,519 | $4,105 | $4,634 |
| (2) Station and Terminal Labor | 667 | 667 | 667 | 667 | 1,042 | 1,042 | 1,042 | 1,042 | 1,042 | 1,042 |
| (3) Tank Maintenance | 70 | 70 | 70 | 70 | 70 | 100 | 100 | 100 | 100 | 100 |
| (4) Pipeline Maintenance | 1,203 | 1,203 | 1,203 | 1,203 | 1,203 | 1,203 | 1,203 | 1,203 | 1,203 | 1,203 |
| (5) Communications | 455 | 455 | 455 | 455 | 455 | 455 | 455 | 455 | 455 | 455 |
| Subtotal | 3,021 | 3,247 | 3,594 | 3,978 | 4,804 | 5,364 | 5,833 | 6,319 | 6,905 | 7,434 |
| *(6) Administration | 958 | 958 | 958 | 958 | 1,108 | 1,120 | 1,120 | 1,120 | 1,120 | 1,120 |
| Total | $3,979 | $4,205 | $4,552 | $4,936 | $5,912 | $6,484 | $6,953 | $7,439 | $8,025 | $8,554 |

* Administration is computed as 40% of items (2), (3), (4) and (5).
Small tools, supplies, and automotive and maintenance equipment are included in station and pipeline maintenance and administration costs.

## 3. STATION OPERATING COST EXCLUDING LABOR AND TANKAGE

| Southern Route | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| Operating Horsepower per Hour | | | | | | | | | | |
| Calgary-Britamoil Jct. | 5 | 6 | 7 | 12 | 45 | 132 | 268 | 272 | 284 | 296 |
| Booster Pumps | | | | | 19 | 23 | 27 | 28 | 28 | 28 |
| Britamoil Jct.-Bellshill Lake | 229 | 345 | 487 | 659 | 856 | 1,086 | 1,355 | 1,392 | 1,448 | 1,488 |
| Booster Pumps | 49 | 55 | 61 | 66 | 72 | 78 | 83 | 84 | 85 | 86 |
| Edmonton-Bellshill Lake | 1,113 | 1,520 | 1,990 | 2,560 | 3,200 | 3,960 | 4,470 | 5,240 | 6,110 | 7,040 |
| Booster Pumps | 150 | 169 | 187 | 206 | 225 | 243 | 255 | 271 | 287 | 303 |
| Bellshill Lake Boosters | 204 | 228 | 253 | 277 | 302 | 326 | 343 | 360 | 377 | 393 |
| Total Without Main Line | 1,750 | 2,323 | 2,985 | 3,780 | 4,719 | 5,848 | 6,801 | 7,647 | 8,619 | 9,634 |
| Main Line, 30" System | 17,480 | 24,420 | 33,850 | 44,000 | 56,900 | 70,200 | 81,600 | 94,100 | 108,300 | 121,000 |
| Total, 30" System | 19,230 | 26,740 | 36,840 | 47,780 | 61,620 | 76,050 | 88,400 | 101,750 | 116,920 | 130,630 |
| Main Line, 34" System | 8,160 | 11,200 | 16,100 | 21,400 | 27,800 | 35,000 | 41,800 | 48,800 | 57,100 | 64,700 |
| Total, 34" System | 9,910 | 13,520 | 19,090 | 25,180 | 32,520 | 40,850 | 48,600 | 56,450 | 65,720 | 74,330 |
| Operating Cost @ $59.00 per Operating BHP: (000 Omitted) | | | | | | | | | | |
| 30" System | $1,135 | $1,578 | $2,174 | $2,819 | $3,636 | $4,487 | $5,216 | $6,003 | $6,898 | $7,707 |
| 34" System | 585 | 798 | 1,126 | 1,486 | 1,919 | 2,410 | 2,867 | 3,331 | 3,877 | 4,385 |

## 3. STATION OPERATING COST EXCLUDING LABOR AND TANKAGE (Cont'd)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| Northern Route | | | | | | | | | | |
| Operating Horsepower per Hour | | | | | | | | | | |
| Main Line, 30" System | 18,770 | 26,150 | 36,200 | 47,000 | 60,250 | 74,900 | 86,800 | 100,160 | 115,200 | 128,800 |
| Total, 30" System | 20,520 | 28,473 | 39,185 | 50,780 | 64,969 | 80,748 | 93,601 | 107,807 | 123,819 | 138,434 |
| Main Line, 34" System | 8,860 | 12,120 | 17,330 | 23,050 | 29,750 | 37,610 | 44,600 | 52,000 | 60,950 | 68,900 |
| Total, 34" System | 10,610 | 14,443 | 20,315 | 26,830 | 34,469 | 43,458 | 51,401 | 59,647 | 69,569 | 78,534 |
| Operating Cost @ $59.00 per Operating BHP: (000 Omitted) | | | | | | | | | | |
| 30" System | $1,211 | $1,680 | $2,312 | $2,996 | $3,833 | $4,764 | $5,522 | $6,361 | $7,305 | $8,168 |
| 34" System | 626 | 852 | 1,199 | 1,583 | 2,034 | 2,564 | 3,033 | 3,519 | 4,105 | 4,634 |

## STATION OPERATING COST DETAILS

| | | |
|---|---|---|
| Fuel (crude oil) consumption per BHP Hour | = 0.35 lb. | |
| Fuel oil cost per barrel, including average transportation cost | = $3.00 | |
| Fuel oil cost per pound | = $0.01 | |
| Fuel oil cost per BHP Hour | = $0.0035 | |
| Fuel oil cost per BHP Year @ 98% Load Factor = 8585 hrs. x $0.0035 | = | $30.05 |
| Lube oil consumption = 1 gallon/3000 BHP Hours | | |
| Lube oil cost per gallon, including average transportation cost | = $0.90 | |
| Lube oil cost per BHP Hour | = $0.003 | |
| Lube oil cost per BHP Year (8585 hrs.) | = | $ 2.60 |
| Repairs and renewals, excluding labor per operating BHP Year (Operating HP is approximately 75% of installed HP for ten-year period) | | $26.00 |
| Total annual operating cost per operating BHP, excluding labor | | $58.65 |
| | | ($59.00) |

## 4. ESTIMATED ANNUAL STATION PERSONNEL EXPENSE

### 1) Edmonton

| | |
|---|---|
| 1 Station superintendent | $ 9,600 |
| 4 Shift operators | 26,400 |
| 1 Electrical technician | 7,200 |
| 1 Electrician | 6,000 |
| 8 Utility men | 33,600 |
| Social benefits | 16,600 |
| | $99,400 |

### 2) Bellshill Lake

| | |
|---|---|
| 1 Station superintendent | $ 9,600 |
| 4 Shift operators | 26,400 |
| 1 Electrical technician | 7,200 |
| 1 Electrician | 6,000 |
| 8 Utility men | 33,600 |
| Social benefits | 16,600 |
| | $99,400 |

### 3) Calgary

| | |
|---|---|
| 1 Station superintendent | $ 8,400 |
| 4 Shift operators | 24,000 |
| Social benefits | 6,500 |
| | $38,900 |

### 4) Britamoil Junction

| | |
|---|---|
| 1 Station superintendent | $ 8,400 |
| 4 Shift operators | 24,000 |
| 2 Utility men | 8,400 |
| Social benefits | 8,200 |
| | $49,000 |

### 5) Montreal Manifold

| | |
|---|---|
| 1 Chief operator | $ 7,800 |
| 4 Shift operators | 24,000 |
| 4 Meter and utility men | 24,000 |
| Social benefits | 11,200 |
| | $67,000 |

| | |
|---|---|
| Total labor excluding Main Line stations | $353,700 |

6) Typical Main Line Station

| | |
|---|---|
| 1 Station superintendent | $ 9,000 |
| 4 Shift operators | 26,400 |
| 4 Utility men | 16,800 |
| Social benefits | 10,400 |
| | $62,600 |

## SUMMARY - SOUTHERN ROUTE

| | 30" System | | 34" System | |
|---|---|---|---|---|
| | 1960-2 | 1963-9 | 1960-3 | 1964-9 |
| | 8 Stations | 16 Stations | 5 Stations | 10 Stations |
| (1) Labor excluding Main Line Stations | $353,700 | $353,700 | $353,700 | $353,700 |
| (2) Station Labor | 438,200 | 939,000 | 250,400 | 563,400 |
| Total | $792,000 | $1,293,000 | $604,000 | $917,000 |

Note: Bellshill Lake is a Main Line station but included under Item (1) and excluded from Item (2).

## SUMMARY - NORTHERN ROUTE

| | 30" System | | 34" System | |
|---|---|---|---|---|
| | 1960-2 | 1963-9 | 1960-3 | 1964-9 |
| | 9 Stations | 18 Stations | 6 Stations | 12 Stations |
| (1) Labor excluding Main Line Stations | $353,700 | $353,700 | $353,700 | $353,700 |
| (2) Station Labor | 500,800 | 1,064,200 | 313,000 | 688,600 |
| Total | $854,500 | $1,417,900 | $666,700 | $1,042,300 |

## 5. ESTIMATED ANNUAL TANK FARM MAINTENANCE

| | TANKAGE In Barrels | |
|---|---|---|
| | 1960-64 | 1965-69 |
| 1) Calgary | 50,000 | 50,000 |
| 2) Britamoil Junction | 30,000 | 30,000 |
| 3) Edmonton | 800,000 | 1,100,000 |
| 4) Bellshill Lake | 877,000 | 1,315,500 |
| Total Barrels | 1,757,000 | 2,495,500 |
| Maintenance Cost per Year @ \$0. 04/barrel | \$ 70,000 | \$ 100,000 |

6. ESTIMATED ANNUAL PIPELINE MAINTENANCE

| | SOUTHERN ROUTE | |
|---|---|---|
| | 30" System | 34" System |
| 1) 73.5 Miles, 10 3/4" OD Pipe @ $250/Mile | $ 18,000 | $ 18,000 |
| 2) 71.5 Miles, 16" OD Pipe @ $250/Mile | 18,000 | 18,000 |
| 3) 100 Miles, 26" OD Pipe @ $350/Mile | 35,000 | 35,000 |
| 4) 750 Miles, 30" Pipe @ $600/Mile | 450,000 | |
| 4a) 750 Miles, 34" OD Pipe @ $700/Mile | | 525,000 |
| 5) 1169 Miles, 30" Pipe @ $400/Mile | 468,000 | |
| 5a) 1169 Miles, 34" OD Pipe @ $450/Mile | | 526,000 |
| TOTAL PIPELINE MAINTENANCE PER YEAR | $ 989,000 | $1,122,000 |
| | NORTHERN ROUTE | |
| Adding 115 Miles @ $600/Mile for 30" $700/Mile for 34" | $1,058,000 | $1,202,500 |

7. ESTIMATED ANNUAL COMMUNICATIONS COST

| | |
|---|---|
| Leased wire and teletype, 2164 Miles of $200/Mile per year, Southern Route | $ 432,000 |
| 2279 Miles of $200/Mile per year, Northern Route | $ 455,000 |

8. OPERATING COSTS IN UNITED STATES, SOUTHERN SYSTEM

30" System — Station Operating Cost Within U.S. (Excluding Labor and Tankage)

| Year | BHP/Station | BHP in U.S. (3 sta. 1960-2) (6 sta. 1963-9) | Operating Cost @ $59.00/BHP |
|---|---|---|---|
| 1960 | 2185 | 6560 | $ 387,000 |
| 1961 | 3052 | 9160 | 540,400 |
| 1962 | 4231 | 12690 | 748,700 |
| 1963 | 2750 | 16500 | 973,500 |
| 1964 | 3556 | 21340 | 1,259,100 |
| 1965 | 4388 | 26330 | 1,553,500 |
| 1966 | 5100 | 30600 | 1,805,400 |
| 1967 | 5881 | 35290 | 2,082,100 |
| 1968 | 6768 | 40610 | 2,396,000 |
| 1969 | 7562 | 45370 | 2,676,800 |

34" System

| Year | BHP/Station | (2 sta. 1960-3) (4 sta. 1964-9) | Operating Cost |
|---|---|---|---|
| 1960 | 1632 | 3264 | $ 192,600 |
| 1961 | 2240 | 4480 | 264,300 |
| 1962 | 3220 | 6440 | 380,000 |
| 1963 | 4280 | 8560 | 505,000 |
| 1964 | 2780 | 11120 | 656,100 |
| 1965 | 3500 | 14000 | 826,000 |
| 1966 | 4180 | 16720 | 986,480 |
| 1967 | 4880 | 19520 | 1,151,700 |
| 1968 | 5710 | 22840 | 1,347,600 |
| 1969 | 6470 | 25880 | 1,527,000 |

## Station Labor Expense in U.S.

$ 62,600/ Main Line Station

| 30" System | | 34" System | |
|---|---|---|---|
| 1960-2 | 1963-9 | 1960-3 | 1964-9 |
| 3 Stations | 6 Stations | 2 Stations | 4 Stations |
| $187,800 | $375,600 | $125,200 | $250,400 |

## Pipeline Maintenance - Estimated Annual in U.S.

Milepost out of U.S. = 1471.0
Milepost into U.S. = 703.5
767.5 Miles in U.S.

| | 30" System | 34" System |
|---|---|---|
| 200 Miles, 30" O. D. Pipe @ $600/Mile | 120,000 | |
| 200 Miles, 34" O. D. Pipe @ $700/Mile | | 140,000 |
| 567.5 Miles, 30" O. D. Pipe @ $400/Mile | 227,000 | |
| 567.5 Miles, 34" O. D. Pipe @ $450/Mile | | 255,400 |
| | $347,000 | $395,400 |

## Communications Cost in U.S.

767.5 Miles @ $200/Mile $153,500

## U.S. PORTION - ANNUAL OPERATING COSTS

(000 Omitted)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| 30" System | | | | | | | | | | |
| (1) Stations, excluding labor and tankage | $ 387 | $ 540 | $ 749 | $ 974 | $1,259 | $1,554 | $1,805 | $2,082 | $2,396 | $2,677 |
| (2) Station and Terminal Labor | 188 | 188 | 188 | 376 | 376 | 376 | 376 | 376 | 376 | 376 |
| (3) Pipeline Maintenance | 347 | 347 | 347 | 347 | 347 | 347 | 347 | 347 | 347 | 347 |
| (4) Communications | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 |
| Subtotal | 1,076 | 1,229 | 1,438 | 1,851 | 2,136 | 2,431 | 2,682 | 2,959 | 3,273 | 3,554 |
| (5) Administration | 276 | 276 | 276 | 351 | 351 | 351 | 351 | 351 | 351 | 351 |
| Total | $1,352 | $1,505 | $1,714 | $2,202 | $2,487 | $2,782 | $3,033 | $3,310 | $3,624 | $3,905 |
| 34" System | | | | | | | | | | |
| (1) Stations, excluding labor and tankage | $ 193 | $ 264 | $ 380 | $ 505 | $ 656 | $ 826 | $ 986 | $1,152 | $1,348 | $1,527 |
| (2) Station and Terminal Labor | 125 | 125 | 125 | 125 | 250 | 250 | 250 | 250 | 250 | 250 |
| (3) Pipeline Maintenance | 395 | 395 | 395 | 395 | 395 | 395 | 395 | 395 | 395 | 395 |
| (4) Communications | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 | 154 |
| Subtotal | 867 | 938 | 1,054 | 1,179 | 1,455 | 1,625 | 1,785 | 1,951 | 2,147 | 2,326 |
| (5) Administration | 270 | 270 | 270 | 270 | 320 | 320 | 320 | 320 | 320 | 320 |
| Total | $1,137 | $1,208 | $1,324 | $1,449 | $1,775 | $1,945 | $2,105 | $2,271 | $2,467 | $2,64[illegible] |

Note: No tank maintenance in the United States

## 9. OPERATING COSTS IN CANADA, SOUTHERN SYSTEM

Main Line Station Operating Costs, within Canada (excluding labor and tankage)

### 30" System

| Year | BHP/Sta. (Main Line only) | BHP in Canada (Main Line only) ( 5 Sta. 1960-2) (10 Sta. 1963-9) | Total BHP (without Main Line) | Total, 30" System in Canada | Operating Costs @ $59.00/BHP |
|---|---|---|---|---|---|
| 1960 | 2,185 | 10,930 | 1,750 | 12,680 | $ 748,120 |
| 1961 | 3,052 | 15,260 | 2,323 | 17,583 | 1,037,400 |
| 1962 | 4,231 | 21,155 | 2,985 | 24,140 | 1,424,300 |
| 1963 | 2,750 | 27,500 | 3,780 | 31,280 | 1,845,500 |
| 1964 | 3,556 | 35,560 | 4,719 | 40,279 | 2,376,460 |
| 1965 | 4,388 | 43,880 | 5,848 | 49,728 | 2,933,950 |
| 1966 | 5,100 | 51,000 | 6,801 | 57,801 | 3,410,260 |
| 1967 | 5,881 | 58,810 | 7,647 | 66,457 | 3,920,960 |
| 1968 | 6,768 | 67,680 | 8,619 | 76,299 | 4,501,640 |
| 1969 | 7,562 | 75,620 | 9,634 | 85,254 | 5,029,990 |

### 34" System

| | | (3 Sta. 1960-3) (6 Sta. 1963-9) | | Total, 34" | |
|---|---|---|---|---|---|
| 1960 | 1,632 | 4,896 | 1,750 | 6,646 | $ 392,110 |
| 1961 | 2,240 | 6,720 | 2,323 | 9,043 | 533,540 |
| 1962 | 3,220 | 9,660 | 2,985 | 12,645 | 746,060 |
| 1963 | 4,280 | 12,840 | 3,780 | 16,620 | 980,580 |
| 1964 | 2,780 | 16,680 | 4,719 | 21,399 | 1,262,540 |
| 1965 | 3,500 | 21,000 | 5,848 | 26,848 | 1,584,030 |
| 1966 | 4,180 | 25,080 | 6,801 | 31,881 | 1,880,980 |
| 1967 | 4,880 | 29,280 | 7,647 | 36,927 | 2,178,690 |
| 1968 | 5,710 | 34,260 | 8,619 | 42,879 | 2,529,860 |
| 1969 | 6,470 | 38,820 | 9,634 | 48,454 | 2,858,790 |

Station Labor Expense in Canada

Typical Main Line Station - $62,600/year

| | 30" System | | 34" System | |
|---|---|---|---|---|
| | 1960-2 | 1963-9 | 1960-3 | 1964-9 |
| | 5 Stations | 10 Stations | 3 Stations | 6 Stations |
| 1) Labor excluding Main Line Stations | $353,700 | $353,700 | $353,700 | $353,700 |
| 2) Station Labor | 250,000 | 563,400 | 125,200 | 313,000 |
| Total | $603,700 | $917,100 | $478,900 | $666,700 |

Note: Bellshill Lake is a Main Line station but included under Item (1) and excluded from Item (2).

Pipeline Maintenance - Estimated Annual in Canada

| | 30" System | 34" System |
|---|---|---|
| 1) 73.5 Miles, 10 3/4" O. D. Pipe @ $250/mile | $ 18,000 | $ 18,000 |
| 2) 71.5 Miles, 16" O. D. Pipe @ $250/mile | 18,000 | 18,000 |
| 3) 100 Miles, 26" O. D. Pipe @ $350/mile | 35,000 | 35,000 |
| 4) 550 Miles, 30" O. D. Pipe @ $600/mile | 330,000 | |
| 5) 550 Miles, 34" O. D. Pipe @ $700/mile | | 385,000 |
| 6) 601.5 Miles, 30" O. D. Pipe @ $400/mile | 240,600 | |
| 7) 601.5 Miles, 34" O. D. Pipe @ $450/mile | | 270,700 |
| Total pipeline maintenance cost/year | $641,600 | $726,700 |

Communications

| | |
|---|---|
| 1396.5 Miles @ $200/mile/year | $279,300 |

## CANADIAN PORTION - ANNUAL OPERATING COSTS

(000 Omitted)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| **30" System** | | | | | | | | | | |
| (1) Stations, excluding labor and tankage | $ 748 | $1,037 | $1,424 | $1,846 | $2,376 | $2,934 | $3,410 | $3,921 | $4,502 | $5,030 |
| (2) Station and Terminal Labor | 604 | 604 | 604 | 917 | 917 | 917 | 917 | 917 | 917 | 917 |
| (3) Tank Maintenance | 70 | 70 | 70 | 70 | 70 | 100 | 100 | 100 | 100 | 100 |
| (4) Pipeline Maintenance | 642 | 642 | 642 | 642 | 642 | 642 | 642 | 642 | 642 | 642 |
| (5) Communications | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 |
| Subtotal | 2,343 | 2,632 | 3,019 | 3,754 | 4,284 | 4,872 | 5,348 | 5,859 | 6,440 | 6,968 |
| (6) Administration | 638 | 638 | 638 | 763 | 763 | 775 | 775 | 775 | 775 | 775 |
| Total | $2,981 | $3,270 | $3,657 | $4,517 | $5,047 | $5,647 | $6,123 | $6,634 | $7,215 | $7,743 |
| **34" System** | | | | | | | | | | |
| (1) Stations, excluding labor and tankage | $ 392 | $ 534 | $ 746 | $ 981 | $1,263 | $1,584 | $1,881 | $2,179 | $2,530 | $2,859 |
| (2) Station and Terminal Labor | 479 | 479 | 479 | 479 | 667 | 667 | 667 | 667 | 667 | 667 |
| (3) Tank Maintenance | 70 | 70 | 70 | 70 | 70 | 100 | 100 | 100 | 100 | 100 |
| (4) Pipeline Maintenance | 727 | 727 | 727 | 727 | 727 | 727 | 727 | 727 | 727 | 727 |
| (5) Communications | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 | 279 |
| Subtotal | 1,947 | 2,089 | 2,301 | 2,536 | 3,006 | 3,357 | 3,654 | 3,952 | 4,303 | 4,632 |
| (6) Administration | 622 | 622 | 622 | 622 | 697 | 709 | 709 | 709 | 709 | 709 |
| Total | $2,569 | $2,711 | $2,923 | $3,158 | $3,703 | $4,066 | $4,363 | $4,661 | $5,012 | $5,341 |
| **30" System** | | | | | | | | | | |
| Operating Cost - Canada | $2,981 | $3,270 | $3,657 | $4,517 | $5,047 | $5,647 | $6,123 | $6,634 | $7,215 | $7,743 |
| Operating Cost - U.S. | 1,352 | 1,505 | 1,714 | 2,202 | 2,487 | 2,782 | 3,033 | 3,310 | 3,624 | 3,905 |
| Total | $4,333 | $4,775 | $5,371 | $6,719 | $7,534 | $8,429 | $9,156 | $9,944 | $10,839 | $11,648 |
| **34" System** | | | | | | | | | | |
| Operating Cost - Canada | $2,569 | $2,711 | $2,923 | $3,158 | $3,703 | $4,066 | $4,363 | $4,661 | $5,012 | $5,341 |
| Operating Cost - U.S. | 1,137 | 1,208 | 1,324 | 1,449 | 1,775 | 1,945 | 2,105 | 2,271 | 2,467 | 2,646 |
| Total | $3,706 | $3,919 | $4,247 | $4,607 | $5,478 | $6,011 | $6,468 | $6,932 | $7,479 | $7,987 |

## C. FINANCIAL DATA

1. DISCUSSION

a. Alternate Systems

Financial projections have been made of both 30" and 34" Systems, following two different routes. The Southern Route includes a portion within the United States. Such portion has been treated herein as a separate company, subsidiary to the Canadian portion. The studies here presented are designated as follows:

1. (a) Southern Alternate - 30" System
   (b) U.S. Subsidiary - 30" System

2. (a) Southern Alternate - 34" System
   (b) U.S. Subsidiary - 34" System

3. Northern Alternate - 30" System

4. Northern Alternate - 34" System

b. Financial Data and Assumptions

Basic construction costs are set out earlier in this report. From these a schedule of capital requirements and sources of capital has been prepared.

Interest during the 1958-59 construction period has been provided at 5.25%, the assumed average annual interest rate, for a period of nine months. Interest during construction on facilities constructed in later years has been provided at the rate of 2.125% which represents interest for about five months. Basic is the assumption that all new facilities will be put into operation as of the beginning of the following calendar year.

Working capital has been provided in an amount equal to 90 days or 25% of the estimated fifth year operating expense.

Line fill, a substantial item, has been assumed to be the responsibility of the pipeline and has been computed at a cost of $2.70 per barrel.

Finance expense has been provided in an amount equal to 2.027% of total capital requirements or 2.07% of such requirements exclusive of that for finance expense. This percentage

is an average for the several types of securities here involved and is patterned closely to the cost of recent issues of comparable new companies.

As sources of capital the following proportions might be assumed. Those in the first column have been used. They closely approximate those of a number of large transmission lines.

| | | |
|---|---|---|
| Mortgage bonds | 55% | 65% |
| Debentures | 30% | 20% |
| Common stock | 15% | 15% |
| Total | 100% | 100% |

Quite possibly the mortgage bonds will be placed privately. The debentures and common stock likely will be sold publicly in units.

For these purposes the borrowing by both mortgages and debentures has been treated as a single debt. An average interest rate of 5.25% has been assumed. Probably that for mortgages will be a little less and that for debentures a little more.

Debt reduction has been computed as straight line annual sinking fund payments of 1/21 of the total debt beginning in the year 1963. For the purposes of computing annual interest all borrowings, subsequent to the initial 1958-59 period, and all repayments have been treated as occurring at mid-year.

Operating expense for each year is set out earlier in the report.

Advalorem or property taxes have been provided at the rate of 1.2% of initial cost of all fixed assets in Canada and 2.0% of those in the United States.

Depreciation has been computed at the composite straight line rate of 3.5% per annum on the beginning of the year investment.

Interest and amortization of finance expense is the aggregate of interest, computed as heretofore described, and amortization of finance expense at the rate of 4% per annum.

For the purposes of computing cost of service there has

been included a return of 7.5% on total investment reduced by accumulated straight line depreciation. This return is, in the cost of service schedules, the total of the columns entitled "interest" and "required net profit".

Income taxes have been provided at 47% for Canadian profits and 54% of those in the United States. Income taxes shown as expense or cost are computed on profits based on straight line 3.5% depreciation. Such taxes are divided into two categories, paid and deferred, on the assumption that taxes will be paid on profits after deducting 6.5% declining balance depreciation. This difference in book and tax depreciation affects nothing except the conservation of cash during the first ten years of operations.

c. Statements

For each alternate system the cost of service has been first computed for each of the years 1960-69, inclusive. Taking into account numerous economic factors, including the financibility of the systems, the cost of service per barrel indicated for 1964, the fifth year of operation, has been selected as an illustrative tariff.

Then, based upon such illustrative tariff and annual throughputs, provided and set out earlier in this report, pro forma financial statements for the two 30" systems have been prepared.

For cost of service and pro forma statement purposes the transportation costs through the United States portion of the Southern Alternate has been treated as a cost to the Canadian system. Thus, the Canadian system collects a tariff for the entire shipment and pays to the U.S. subsidiary the portion allocable to it. In reviewing the income statements and balance sheets of the Southern Alternate it must be remembered that profits, assets, debts, capital, etc. are reflected partly in the statements for the Southern Alternate and partly in those for the U.S. Subsidiary.

For purposes of ready comparison there follows a tabulation of the per barrel cost of service of each alternate for each year. These figures are, of course, based upon the foregoing assumptions and assumed throughputs, consistently applied.

| Year | 30" Systems | | 34" Systems | |
|---|---|---|---|---|
| | Southern | Northern | Southern | Northern |
| 1960 | $ .758 | $ .823 | $ .845 | $ .938 |
| 1961 | .665 | .727 | .735 | .813 |
| 1962 | .605 | .662 | .646 | .715 |
| 1963 | .553 | .605 | .589 | .652 |
| 1964 | .518 | .566 | .543 | .602 |
| 1965 | .479 | .522 | .500 | .555 |
| 1966 | .454 | .494 | .471 | .522 |
| 1967 | .438 | .479 | .448 | .495 |
| 1968 | .415 | .454 | .421 | .465 |
| 1969 | .396 | .432 | .399 | .440 |

Hereafter there is presented, for the two 30" systems, the following pro forma statements:

Income and Expense

Balance Sheets

Cash Receipts and Disbursements

Capitalization

Cost of Service

Fixed Assets, Depreciation and Deferred Income Taxes

Debt Service

There is also submitted cost of service studies of the 34" alternates.

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA STATEMENT OF INCOME AND EXPENSE

(000 OMITTED)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| Revenue | $ 37,814 | $ 42,352 | $ 46,889 | $ 51,427 | $ 55,971 | $ 60,502 | $ 63,603 | $ 66,186 | $ 69,805 | $ 72,905 |
| Revenue Deductions | | | | | | | | | | |
| Operating Expense | 2,981 | 3,270 | 3,657 | 4,517 | 5,047 | 5,647 | 6,123 | 6,634 | 7,215 | 7,743 |
| Depreciation (Straight Line) | 7,645 | 7,645 | 7,659 | 7,902 | 7,909 | 8,137 | 8,137 | 8,149 | 8,269 | 8,269 |
| Ad Valorem Tax | 2,621 | 2,621 | 2,621 | 2,709 | 2,711 | 2,789 | 2,789 | 2,793 | 2,835 | 2,835 |
| Transportation Through U.S. Subsidiary | 12,191 | 13,654 | 15,117 | 16,580 | 17,995 | 19,507 | 20,505 | 21,338 | 22,505 | 23,504 |
| Income Taxes | | | | | | | | | | |
| Paid | | | | | 2,797 | 5,188 | 6,544 | 7,594 | 8,955 | 10,242 |
| Deferred | 526 | 1,824 | 3,063 | 3,927 | 2,594 | 1,319 | 994 | 780 | 424 | 144 |
| Total | 25,964 | 29,014 | 32,117 | 35,635 | 39,053 | 42,587 | 45,092 | 47,288 | 50,203 | 52,737 |
| Net Income Before Interest | 11,850 | 13,338 | 14,772 | 15,792 | 16,918 | 17,915 | 18,511 | 18,898 | 19,602 | 20,168 |
| Interest and Amortization of Finance Expense | 11,257 | 11,281 | 11,318 | 11,364 | 10,839 | 10,578 | 10,011 | 9,455 | 9,025 | 8,457 |
| Annual Net Income | 593 | 2,057 | 3,454 | 4,428 | 6,079 | 7,337 | 8,500 | 9,443 | 10,577 | 11,711 |
| Cumulative Earned Surplus | 593 | 2,650 | 6,104 | 10,532 | 16,611 | 23,948 | 32,448 | 41,891 | 52,468 | 64,179 |
| Rate Base (Capital less Depreciation) | 242,594 | 235,349 | 234,690 | 226,988 | 225,579 | 217,442 | 209,605 | 204,014 | 195,745 | 187,476 |
| Return on Rate Base | 4.9% | 5.7% | 6.3% | 7.0% | 7.5% | 8.2% | 8.8% | 9.3% | 10.0% | 10.7% |
| Return on Common Stock | 1.5% | 5.1% | 8.6% | 11.1% | 15.2% | 18.3% | 21.2% | 23.6% | 26.4% | 29.3% |
| Ratio of Cash Available From Earning to Interest Expense | 1.8 | 2.1 | 2.4 | 2.5 | 2.5 | 2.6 | 2.9 | 2.9 | 3.2 | 3.4 |

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA BALANCE SHEETS

(000 OMITTED)

| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assets** | | | | | | | | | | | |
| Fixed Assets | $218,426 | $218,426 | $218,823 | $225,766 | $225,971 | $232,484 | $232,484 | $ 232,821 | $236,248 | $236,248 | $236,248 |
| Reserve for Depreciation | | 7,645 | 15,290 | 22,949 | 30,851 | 38,760 | 46,897 | 55,034 | 63,183 | 71,452 | 79,721 |
| Remainder | 218,426 | 210,781 | 203,533 | 202,817 | 195,120 | 193,724 | 185,587 | 177,787 | 173,065 | 164,796 | 156,527 |
| Cash | 864 | 9,852 | 21,605 | 36,062 | 41,723 | 47,701 | 53,903 | 60,906 | 67,818 | 76,497 | 86,030 |
| Working Capital | 1,262 | 1,262 | 1,262 | 1,262 | 1,262 | 1,262 | 1,262 | 1,262 | 1,262 | 1,262 | 1,262 |
| Line Fill | 24,089 | 24,089 | 24,089 | 24,089 | 24,089 | 24,089 | 24,089 | 24,089 | 24,089 | 24,089 | 24,089 |
| Unamortized Finance Expense | 5,598 | 5,374 | 5,150 | 4,926 | 4,702 | 4,478 | 4,254 | 4,030 | 3,806 | 3,582 | 3,358 |
| Total | 250,239 | 251,358 | 255,639 | 269,156 | 266,896 | 271,254 | 269,095 | 268,074 | 270,040 | 270,226 | 271,266 |
| **Liabilities and Capital** | | | | | | | | | | | |
| Common Stock | 40,080 | 40,080 | 40,080 | 40,080 | 40,080 | 40,080 | 40,080 | 40,080 | 40,080 | 40,080 | 40,080 |
| Long Term Debts | 210,159 | 210,159 | 210,559 | 217,559 | 206,944 | 202,629 | 191,814 | 181,299 | 173,042 | 162,227 | 151,412 |
| Reserve for Deferred Income Taxes | | 526 | 2,350 | 5,413 | 9,340 | 11,934 | 13,253 | 14,247 | 15,027 | 15,451 | 15,595 |
| Earned Surplus | | 593 | 2,650 | 6,104 | 10,532 | 16,611 | 23,948 | 32,448 | 41,891 | 52,468 | 64,179 |
| Total | 250,239 | 251,358 | 255,639 | 269,156 | 266,896 | 271,254 | 269,095 | 268,074 | 270,040 | 270,226 | 271,266 |

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS

(000 OMITTED)

| Cash Receipts | 1958-59 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From Operations | | | | | | | | | | | |
| Net Profit | $ | $ 593 | $ 2,057 | $ 3,454 | $ 4,428 | $ 6,079 | $ 7,337 | $ 8,500 | $ 9,443 | $10,577 | $11,711 |
| Depreciation | | 7,645 | 7,645 | 7,659 | 7,902 | 7,909 | 8,137 | 8,137 | 8,149 | 8,269 | 8,269 |
| Deferred Income Tax | | 526 | 1,824 | 3,063 | 3,927 | 2,594 | 1,319 | 994 | 780 | 424 | 144 |
| Amortization of Finance Expense | | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 | 224 |
| Total | | 8,988 | 11,750 | 14,400 | 16,481 | 16,806 | 17,017 | 17,855 | 18,596 | 19,494 | 20,348 |
| Borrowed Capital | 210,159 | | 400 | 7,000 | 200 | 6,500 | | 300 | 2,558 | | |
| Common Stock | 40,080 | | | | | | | | | | |
| Total | 250,239 | 8,988 | 12,150 | 21,400 | 16,681 | 23,306 | 17,017 | 18,155 | 21,154 | 19,494 | 20,348 |
| **Cash Disbursements** | | | | | | | | | | | |
| Construction | 210,151 | | 389 | 6,799 | 201 | 6,377 | | 330 | 3,356 | | |
| Interest during Construction | 8,275 | | 8 | 144 | 4 | 136 | | 7 | 71 | | |
| Line Fill | 24,089 | | | | | | | | | | |
| Working Capital | 1,262 | | | | | | | | | | |
| Finance Expense | 5,598 | | | | | | | | | | |
| Debt Reduction | | | | | 10,815 | 10,815 | 10,815 | 10,815 | 10,815 | 10,815 | 10,815 |
| Total | 249,375 | | 397 | 6,943 | 11,020 | 17,328 | 10,815 | 11,152 | 14,242 | 10,815 | 10,815 |
| Annual Excess of Cash Receipts | 864 | 8,988 | 11,753 | 14,457 | 5,661 | 5,978 | 6,202 | 7,003 | 6,912 | 8,679 | 9,533 |
| Cumulative Cash Balance | 864 | 9,852 | 21,605 | 36,062 | 41,723 | 47,701 | 53,903 | 60,906 | 67,818 | 76,497 | 86,030 |

## ALBERTA-MONTREAL PIPELINE

## SOUTHERN ALTERNATE -- 30" SYSTEM

## CAPITALIZATION

(000 OMITTED)

| | 1958-59 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Requirements | | | | | | | | | | |
| Construction | $ 210,151 | | $ 389 | $ 6,799 | $ 201 | $ 6,377 | | $ 330 | $ 3,356 | $ 227,603 |
| Interest during Construction | 8,275 | | 8 | 144 | 4 | 136 | | 7 | 71 | 8,645 |
| Total | 218,426 | | 397 | 6,943 | 205 | 6,513 | | 337 | 3,427 | 236,248 |
| Working Capital | 1,262 | | | | | | | | | 1,262 |
| Line Fill | 24,089 | | | | | | | | | 24,089 |
| Finance Expense | 5,598 | | | | | | | | | 5,598 |
| Total | 249,375 | | 397 | 6,943 | 205 | 6,513 | | 337 | 3,427 | 267,197 |
| Sources of Capital | | | | | | | | | | |
| Borrowed Capital | | | | | | | | | | |
| Mortgages | 130,000 | | 400 | 7,000 | 200 | 6,500 | | 300 | 2,558 | 146,958 |
| Debentures | 80,159 | | | | | | | | | 80,159 |
| Total | 210,159 | | 400 | 7,000 | 200 | 6,500 | | 300 | 2,558 | 227,117 |
| Common Stock | 40,080 | | | | | | | | | 40,080 |
| Total | 250,239 | | 400 | 7,000 | 200 | 6,500 | | 300 | 2,558 | 267,197 |

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

COST OF SERVICE

(000 OMITTED)

| Year | Operating Expense | Ad Valorem Tax | Straight Line Depreciation | Interest and Amortization | U.S. Subsidiary's Cost of Service | Normalized Income Tax | Required Net Profit | Total Cost of Service | MBP Yr. | Cost of Service Per Bbl. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | $ 2,981 | $ 2,621 | $ 7,645 | $ 11,257 | $ 17,905 | $ 6,064 | $ 6,838 | $ 55,311 | 73,000 | $ 0.758 |
| 1961 | 3,270 | 2,621 | 7,645 | 11,281 | 17,497 | 5,649 | 6,370 | 54,333 | 81,760 | 0.665 |
| 1962 | 3,657 | 2,621 | 7,659 | 11,318 | 17,691 | 5,573 | 6,284 | 54,803 | 90,520 | 0.605 |
| 1963 | 4,517 | 2,709 | 7,902 | 11,364 | 17,720 | 5,019 | 5,660 | 54,891 | 99,280 | 0.553 |
| 1964 | 5,047 | 2,711 | 7,909 | 10,839 | 17,995 | 5,391 | 6,079 | 55,971 | 108,040 | 0.518 |
| 1965 | 5,647 | 2,789 | 8,137 | 10,578 | 17,955 | 5,081 | 5,730 | 55,917 | 116,800 | 0.479 |
| 1966 | 6,123 | 2,789 | 8,137 | 10,011 | 17,876 | 5,063 | 5,709 | 55,708 | 122,786 | 0.454 |
| 1967 | 6,634 | 2,793 | 8,149 | 9,455 | 17,929 | 5,184 | 5,846 | 55,990 | 127,772 | 0.438 |
| 1968 | 7,215 | 2,835 | 8,269 | 9,025 | 17,938 | 5,016 | 5,656 | 55,954 | 134,758 | 0.415 |
| 1969 | 7,743 | 2,835 | 8,269 | 8,457 | 17,895 | 4,970 | 5,604 | 55,773 | 140,744 | 0.396 |

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

FIXED ASSETS, DEPRECIATION AND DEFERRED INCOME TAXES

(000 OMITTED)

| Year | Cost | | Straight Line Depreciation @ 3.5% | | Declining Balance Tax Depreciation @ 6.5% | | Excess of Tax Depreciation | Income Taxes Deferred | |
|---|---|---|---|---|---|---|---|---|---|
| | Addition | Balance | Annual | Reserve | Annual | Remaining | | Annual | Cumulative |
| 1958-59 | $ 218,426 | $ 218,426 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 1960 | | 218,426 | 7,645 | 7,645 | 14,198 | 204,228 | 6,553 | 3,080 | 3,080 |
| 1961 | 397 | 218,823 | 7,645 | 15,290 | 13,301 | 191,324 | 5,656 | 2,658 | 5,738 |
| 1962 | 6,943 | 225,766 | 7,659 | 22,949 | 12,887 | 185,380 | 5,228 | 2,457 | 8,195 |
| 1963 | 205 | 225,971 | 7,902 | 30,851 | 12,063 | 173,522 | 4,161 | 1,956 | 10,151 |
| 1964 | 6,513 | 232,484 | 7,909 | 38,760 | 11,702 | 168,333 | 3,793 | 1,783 | 11,934 |
| 1965 | | 232,484 | 8,137 | 46,897 | 10,942 | 157,391 | 2,805 | 1,318 | 13,252 |
| 1966 | 337 | 232,821 | 8,137 | 55,034 | 10,252 | 147,476 | 2,115 | 994 | 14,246 |
| 1967 | 3,427 | 236,248 | 8,149 | 63,183 | 9,809 | 141,094 | 1,660 | 780 | 15,026 |
| 1968 | | 236,248 | 8,269 | 71,452 | 9,171 | 131,923 | 902 | 424 | 15,450 |
| 1969 | | 236,248 | 8,269 | 79,721 | 8,575 | 123,348 | 306 | 144 | 15,594 |

Until the year 1964 the deferrment of taxes and the reserve therefore on the foregoing income statement and balance sheets does not coincide with the above due to carry forward losses in early year created by tax depreciation.

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 30" SYSTEM

DEBT SERVICE

(000 OMITTED)

| | Principal | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Net Additions (Reductions) | Balance | Interest @ 5.25% | Amortization of Finance Expense | Total | Interest Capitalized During Construction | Interest and Amortization Expense |
| 1958-59 | $ 210,159 | $ 210,159 | $ 8,275 | $ - | $ 8,275 | $ 8,275 | $ - |
| 1960 | | 210,159 | 11,033 | 224 | 11,257 | | 11,257 |
| 1961 | 400 | 210,559 | 11,065 | 224 | 11,289 | 8 | 11,281 |
| 1962 | 7,000 | 217,559 | 11,238 | 224 | 11,462 | 144 | 11,318 |
| 1963 | (10,615) | 206,944 | 11,144 | 224 | 11,368 | 4 | 11,364 |
| 1964 | ( 4,315) | 202,629 | 10,751 | 224 | 10,975 | 136 | 10,839 |
| 1965 | (10,815) | 191,814 | 10,354 | 224 | 10,578 | | 10,578 |
| 1966 | (10,515) | 181,299 | 9,794 | 224 | 10,018 | 7 | 10,011 |
| 1967 | ( 8,257) | 173,042 | 9,302 | 224 | 9,526 | 71 | 9,455 |
| 1968 | (10,815) | 162,227 | 8,801 | 224 | 9,025 | | 9,025 |
| 1969 | (10,815) | 151,412 | 8,233 | 224 | 8,457 | | 8,457 |

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

PRO FORMA STATEMENT OF INCOME AND EXPENSE

(000 OMITTED)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| Revenue | $12,191 | $13,654 | $15,117 | $16,580 | $18,043 | $19,506 | $20,505 | $21,338 | $22,505 | $23,504 |
| Revenue Deductions | | | | | | | | | | |
| Operating Expense | 1,352 | 1,505 | 1,714 | 2,202 | 2,487 | 2,782 | 3,033 | 3,310 | 3,624 | 3,905 |
| Straight Line Depreciation | 3,540 | 3,540 | 3,540 | 3,666 | 3,666 | 3,733 | 3,733 | 3,733 | 3,797 | 3,797 |
| Ad Valorem Tax | 2,023 | 2,023 | 2,023 | 2,095 | 2,095 | 2,133 | 2,133 | 2,133 | 2,170 | 2,170 |
| Income Taxes | | | | | | | | | | |
| Paid | | | | | 1,533 | 2,784 | 3,490 | 4,031 | 4,727 | 5,391 |
| Deferred | 296 | 1,004 | 1,670 | 2,062 | 1,286 | 687 | 512 | 411 | 219 | 71 |
| Total | 7,211 | 8,072 | 8,947 | 10,025 | 11,067 | 12,119 | 12,901 | 13,618 | 14,537 | 15,334 |
| Net Income Before Interest | 4,980 | 5,582 | 6,170 | 6,555 | 6,976 | 7,387 | 7,604 | 7,720 | 7,968 | 8,170 |
| Interest and Amortization of Finance Expense | 4,727 | 4,727 | 4,747 | 4,798 | 4,575 | 4,431 | 4,194 | 3,936 | 3,754 | 3,517 |
| Net Income | 253 | 855 | 1,423 | 1,757 | 2,401 | 2,956 | 3,410 | 3,784 | 4,214 | 4,653 |
| Cumulative Earned Surplus | 253 | 1,108 | 2,531 | 4,288 | 6,689 | 9,645 | 13,055 | 16,839 | 21,053 | 25,706 |
| Rate Base (Capital less Depreciation) | 101,437 | 97,997 | 98,057 | 94,391 | 92,725 | 88,992 | 85,259 | 82,030 | 78,233 | 74,536 |
| Rate of Return | 4.9% | 5.7% | 6.3% | 6.9% | 7.5% | 8.3% | 8.9% | 9.4% | 10.2% | 11.0% |
| Rate of Return on Common Stock | 1.5% | 5.2% | 8.5% | 10.5% | 14.4% | 17.5% | 20.5% | 22.6% | 25.2% | 27.8% |
| Ratio of Cash Available From Earnings to Interest Expense | 1.9 | 2.1 | 2.4 | 2.6 | 2.6 | 2.7 | 2.8 | 3.0 | 3.2 | 3.4 |

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

PRO FORMA BALANCE SHEETS

(000 OMITTED)

| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assets** | | | | | | | | | | | |
| Fixed Assets | $ 101,143 | $ 101,143 | $ 101,143 | $ 104,746 | $ 104,746 | $ 106,664 | $ 106,664 | $ 106,664 | $ 108,481 | $ 108,481 | $ 108,481 |
| Reserve for Depreciation | | 3,540 | 7,080 | 10,620 | 14,286 | 17,952 | 21,685 | 25,418 | 29,151 | 32,948 | 36,745 |
| Balance | 101,143 | 97,603 | 94,063 | 94,126 | 90,460 | 88,712 | 84,979 | 81,246 | 79,330 | 75,533 | 71,736 |
| Cash | 1,134 | 5,310 | 10,796 | 17,513 | 20,585 | 23,607 | 26,570 | 29,812 | 32,114 | 35,931 | 40,039 |
| Working Capital | 622 | 622 | 622 | 622 | 622 | 622 | 622 | 622 | 622 | 622 | 622 |
| Unamortized Finance Expense | 2,178 | 2,091 | 2,004 | 1,917 | 1,830 | 1,743 | 1,656 | 1,569 | 1,482 | 1,395 | 1,308 |
| Total | 105,077 | 105,626 | 107,485 | 114,178 | 113,497 | 114,684 | 113,827 | 113,249 | 113,548 | 113,481 | 113,705 |
| **Liabilities and Capital** | | | | | | | | | | | |
| Capital Stock | 16,693 | 16,693 | 16,693 | 16,693 | 16,693 | 16,693 | 16,693 | 16,693 | 16,693 | 16,693 | 16,693 |
| Long Term Debts | 88,384 | 88,384 | 88,384 | 91,984 | 87,484 | 84,984 | 80,484 | 75,984 | 72,088 | 67,588 | 63,088 |
| Reserve for Deferred Income Taxes | | 296 | 1,300 | 2,970 | 5,032 | 6,318 | 7,005 | 7,517 | 7,928 | 8,147 | 8,218 |
| Earned Surplus | | 253 | 1,108 | 2,531 | 4,288 | 6,689 | 9,645 | 13,055 | 16,839 | 21,053 | 25,706 |
| Total | 105,077 | 105,626 | 107,485 | 114,178 | 113,497 | 114,684 | 113,827 | 113,249 | 113,548 | 113,481 | 113,705 |

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

PRO FORMA STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS

(000 OMITTED)

| | 1958-59 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cash Receipts | | | | | | | | | | | |
| Earnings | | | | | | | | | | | |
| Net Profit | $ | $ 253 | $ 855 | $ 1,423 | $ 1,757 | $ 2,401 | $ 2,956 | $ 3,410 | $ 3,784 | $ 4,214 | $ 4,653 |
| Depreciation | | 3,540 | 3,540 | 3,540 | 3,666 | 3,666 | 3,733 | 3,733 | 3,733 | 3,797 | 3,797 |
| Deferred Income Taxes | | 296 | 1,004 | 1,670 | 2,062 | 1,286 | 687 | 512 | 411 | 219 | 71 |
| Amortization of Finance Expense | | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 |
| Total | | 4,176 | 5,486 | 6,720 | 7,572 | 7,440 | 7,463 | 7,742 | 8,015 | 8,317 | 8,608 |
| Borrowed Capital | 88,384 | | | 3,600 | | 2,000 | | | 604 | | |
| Common Stock | 16,693 | | | | | | | | | | |
| Total | 105,077 | 4,176 | 5,486 | 10,320 | 7,572 | 9,440 | 7,463 | 7,742 | 8,619 | 8,317 | 8,608 |
| Cash Disbursements | | | | | | | | | | | |
| Construction | 97,311 | | | 3,528 | | 1,879 | | | 1,779 | | |
| Interest during Construction | 3,832 | | | 75 | | 39 | | | 38 | | |
| Finance Expense | 2,178 | | | | | | | | | | |
| Working Capital | 622 | | | | | | | | | | |
| Debt Reduction | | | | | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 | 4,500 |
| Total | 103,943 | | | 3,603 | 4,500 | 6,418 | 4,500 | 4,500 | 6,317 | 4,500 | 4,500 |
| Annual Excess of Receipts | 1,134 | 4,176 | 5,486 | 6,717 | 3,072 | 3,022 | 2,963 | 3,242 | 2,302 | 3,817 | 4,108 |
| Cumulative Cash Balance | 1,134 | 5,310 | 10,796 | 17,513 | 20,585 | 23,607 | 26,570 | 29,812 | 32,114 | 35,931 | 40,039 |

## ALBERTA-MONTREAL PIPELINE

## U.S. SUBSIDIARY -- 30" SYSTEM

## CAPITALIZATION

(000 OMITTED)

| | 1958-59 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **Capital Requirements** | | | | | | | | | | |
| Construction | $ 97,311 | | | $ 3,528 | | $ 1,879 | | | $ 1,779 | $ 104,497 |
| Interest during Construction | 3,832 | | | 75 | | 39 | | | 38 | 3,984 |
| Total | 101,143 | | | 3,603 | | 1,918 | | | 1,817 | 108,481 |
| Working Capital | 622 | | | | | | | | | 622 |
| Finance Expense | 2,178 | | | | | | | | | 2,178 |
| Total | 103,943 | | | 3,603 | | 1,918 | | | 1,817 | 111,281 |
| **Sources of Capital** | | | | | | | | | | |
| Borrowed Capital | | | | | | | | | | |
| Mortgages | 55,000 | | | 3,600 | | 2,000 | | | 604 | 61,204 |
| Debentures | 33,384 | | | | | | | | | 33,384 |
| Total | 88,384 | | | 3,600 | | 2,000 | | | 604 | 94,588 |
| Common Stock | 16,693 | | | | | | | | | 16,693 |
| Total | 105,077 | | | 3,600 | | 2,000 | | | 604 | 111,281 |

## ALBERTA-MONTREAL PIPELINE

## U.S. SUBSIDIARY -- 30" SYSTEM

## COST OF SERVICE

(000 OMITTED)

| Year | Operating Expense | Ad Valorem Tax | Straight Line Depreciation | Interest and Amortization | Normalized Income Tax | Required Net Profit | Total Cost of Service | MBP Yr. | Cost of Service Per Bbl. |
|---|---|---|---|---|---|---|---|---|---|
| 1960 | $ 1,352 | $ 2,023 | $ 3,540 | $ 4,727 | $ 3,382 | $ 2,881 | $ 17,905 | 73,000 | $ 0.245 |
| 1961 | 1,505 | 2,023 | 3,540 | 4,727 | 3,079 | 2,623 | 17,497 | 81,760 | 0.214 |
| 1962 | 1,714 | 2,023 | 3,540 | 4,747 | 3,060 | 2,607 | 17,691 | 90,520 | 0.195 |
| 1963 | 2,202 | 2,095 | 3,666 | 4,798 | 2,678 | 2,281 | 17,720 | 99,280 | 0.177 |
| 1964 | 2,487 | 2,095 | 3,666 | 4,575 | 2,793 | 2,379 | 17,995 | 108,040 | 0.167 |
| 1965 | 2,782 | 2,133 | 3,733 | 4,431 | 2,633 | 2,243 | 17,955 | 116,800 | 0.154 |
| 1966 | 3,033 | 2,133 | 3,733 | 4,194 | 2,583 | 2,200 | 17,876 | 122,786 | 0.146 |
| 1967 | 3,310 | 2,133 | 3,733 | 3,936 | 2,601 | 2,216 | 17,929 | 127,772 | 0.140 |
| 1968 | 3,624 | 2,170 | 3,797 | 3,754 | 2,480 | 2,113 | 17,938 | 134,758 | 0.133 |
| 1969 | 3,905 | 2,170 | 3,797 | 3,517 | 2,433 | 2,073 | 17,895 | 140,744 | 0.127 |

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

FIXED ASSETS, DEPRECIATION AND DEFERRED INCOME TAXES

(000 OMITTED)

| | Cost | | Straight Line Depreciation @ 3.5% | | Declining Balance Tax Depreciation @ 6.5% | | Excess of Tax | Income Taxes Deferred | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Addition | Balance | Annual | Reserve | Annual | Remaining | Depreciation | Annual | Cumulative |
| 1958-59 | $ 101,143 | $ 101,143 | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| 1960 | | 101,143 | 3,540 | 3,540 | 6,574 | 94,569 | 3,034 | 1,638 | 1,638 |
| 1961 | | 101,143 | 3,540 | 7,080 | 6,147 | 88,422 | 2,607 | 1,408 | 3,046 |
| 1962 | 3,603 | 104,746 | 3,540 | 10,620 | 5,982 | 86,043 | 2,442 | 1,319 | 4,365 |
| 1963 | | 104,746 | 3,666 | 14,286 | 5,593 | 80,450 | 1,927 | 1,041 | 5,406 |
| 1964 | 1,918 | 106,664 | 3,666 | 17,952 | 5,354 | 77,014 | 1,688 | 912 | 6,318 |
| 1965 | | 106,664 | 3,733 | 21,685 | 5,006 | 72,008 | 1,273 | 687 | 7,005 |
| 1966 | | 106,664 | 3,733 | 25,418 | 4,681 | 67,327 | 948 | 512 | 7,517 |
| 1967 | 1,817 | 108,481 | 3,733 | 29,151 | 4,494 | 64,650 | 761 | 411 | 7,928 |
| 1968 | | 108,481 | 3,797 | 32,948 | 4,202 | 60,448 | 405 | 219 | 8,147 |
| 1969 | | 108,481 | 3,797 | 36,745 | 3,929 | 56,519 | 132 | 71 | 8,218 |

ALBERTA-MONTREAL PIPELINE

U.S. SUBSIDIARY -- 30" SYSTEM

DEBT SERVICE

(000 OMITTED)

| Year | Principal | | Interest | Amortization | Total | Interest | Interest and |
|---|---|---|---|---|---|---|---|
| | Net Additions (Reductions) | Balance | @ 5.25% | of Finance Expense | | Capitalized During Construction | Amortization Expense |
| 1958-59 | $ 88,384 | $ 88,384 | $ 3,832 | $ - | $ 3,832 | $ 3,832 | $ - |
| 1960 | | 88,384 | 4,640 | 87 | 4,727 | | 4,727 |
| 1961 | | 88,384 | 4,640 | 87 | 4,727 | | 4,727 |
| 1962 | 3,600 | 91,984 | 4,735 | 87 | 4,822 | 75 | 4,747 |
| 1963 | (4,500) | 87,484 | 4,711 | 87 | 4,798 | | 4,798 |
| 1964 | (2, 500) | 84,984 | 4,527 | 87 | 4,614 | 39 | 4,575 |
| 1965 | (4, 500) | 80,484 | 4,344 | 87 | 4,431 | | 4,431 |
| 1966 | (4, 500) | 75,984 | 4,107 | 87 | 4,194 | | 4,194 |
| 1967 | (3, 896) | 72,088 | 3,887 | 87 | 3,974 | 38 | 3,936 |
| 1968 | (4, 500) | 67,588 | 3,667 | 87 | 3,754 | | 3,754 |
| 1969 | (4, 500) | 63,088 | 3,430 | 87 | 3,517 | | 3,517 |

## ALBERTA-MONTREAL PIPELINE

## NORTHERN ALTERNATE -- 30" SYSTEM

## PRO FORMA STATEMENT OF INCOME AND EXPENSE

(000 OMITTED)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| Revenue | $ 41,318 | $ 46,271 | $ 51,234 | $ 56,192 | $ 61,151 | $ 65,992 | $ 69,497 | $ 72,319 | $ 76,273 | $ 79,661 |
| Revenue Deductions | | | | | | | | | | |
| Operating Expense | 4,624 | 5,093 | 5,725 | 7,197 | 8,034 | 9,007 | 9,765 | 10,504 | 11,548 | 12,411 |
| Depreciation | 12,763 | 12,763 | 12,777 | 13,209 | 13,216 | 13,544 | 13,544 | 13,556 | 13,772 | 13,772 |
| Ad Valorem Tax | 4,376 | 4,376 | 4,381 | 4,529 | 4,531 | 4,644 | 4,644 | 4,648 | 4,722 | 4,722 |
| Income Tax | | | | | | | | | | |
| Paid | | | | | 652 | 7,609 | 9,907 | 11,652 | 13,804 | 15,866 |
| Deferred | 704 | 2,815 | 4,811 | 6,122 | 7,808 | 2,684 | 2,106 | 1,738 | 1,110 | 617 |
| Total | 22,467 | 25,047 | 27,694 | 31,057 | 34,241 | 37,488 | 39,966 | 42,098 | 44,956 | 47,388 |
| Net Income Before Interest and Amortization of Finance Expense | 18,851 | 21,224 | 23,540 | 25,135 | 26,910 | 28,504 | 29,531 | 30,221 | 31,317 | 32,273 |
| Interest and Amortization of Finance Expense | 18,057 | 18,049 | 18,115 | 18,231 | 17,369 | 16,897 | 15,984 | 15,121 | 14,499 | 13,685 |
| Net Income | 794 | 3,175 | 5,425 | 6,904 | 9,541 | 11,607 | 13,547 | 15,100 | 16,818 | 18,588 |
| Cumulative Earned Surplus | 794 | 3,969 | 9,394 | 16,298 | 25,839 | 37,446 | 50,993 | 66,093 | 82,911 | 101,499 |
| Rate Base (Capital Less Depreciation) | 388,988 | 376,225 | 375,448 | 362,239 | 358,423 | 334,879 | 331,635 | 324,296 | 310,524 | 296,752 |
| Return on Rate Base | 4.8% | 5.6% | 6.3% | 6.9% | 7.5% | 8.5% | 8.9% | 9.3% | 10.1% | 10.9% |
| Return on Common Stock | 1.2% | 4.9% | 8.4% | 10.7% | 14.8% | 18.0% | 21.0% | 23.4% | 26.1% | 28.8% |
| Ratio of Cash Available From Earnings to Interest | 1.8 | 2.0 | 2.3 | 2.4 | 2.8 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 |

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA BALANCE SHEET

(000 OMITTED)

| | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assets** | | | | | | | | | | | |
| Fixed Assets | $364,670 | $364,670 | $365,067 | $377,400 | $377,605 | $386,983 | $386,983 | $387,320 | $393,487 | $393,487 | $393,487 |
| Reserve for Depreciation | | 12,763 | 25,526 | 38,303 | 51,512 | 64,728 | 78,272 | 91,816 | 105,372 | 119,144 | 132,916 |
| Balance | 364,670 | 351,907 | 339,541 | 339,097 | 326,093 | 322,255 | 308,711 | 295,504 | 288,115 | 274,343 | 260,571 |
| Cash | 900 | 15,510 | 34,215 | 57,244 | 66,223 | 79,759 | 90,543 | 102,652 | 116,045 | 130,694 | 146,620 |
| Line Fill | 25,458 | 25,458 | 25,458 | 25,458 | 25,458 | 25,458 | 25,458 | 25,458 | 25,458 | 25,458 | 25,458 |
| Working Capital | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 | 2,009 |
| Unamortized Finance Expense | 8,714 | 8,365 | 8,016 | 7,667 | 7,318 | 6,969 | 6,620 | 6,271 | 5,922 | 5,573 | 5,224 |
| Total | 401,751 | 403,249 | 409,239 | 431,475 | 427,101 | 436,450 | 433,341 | 431,894 | 437,549 | 438,077 | 439,882 |
| **Liabilities and Capital** | | | | | | | | | | | |
| Common Stock | 64,451 | 64,451 | 64,451 | 64,451 | 64,451 | 64,451 | 64,451 | 64,451 | 64,451 | 64,451 | 64,451 |
| Borrowed Capital | 337,300 | 337,300 | 337,300 | 349,300 | 331,900 | 323,900 | 306,500 | 289,400 | 278,217 | 260,817 | 243,417 |
| Reserve for Deferred Income Taxes | | 704 | 3,519 | 8,330 | 14,452 | 22,260 | 24,944 | 27,050 | 28,788 | 29,898 | 30,515 |
| Earned Surplus | | 794 | 3,969 | 9,394 | 16,298 | 25,839 | 37,446 | 50,993 | 66,093 | 82,911 | 101,499 |
| Total | 401,751 | 403,249 | 409,239 | 431,475 | 427,101 | 436,450 | 433,341 | 431,894 | 437,549 | 438,077 | 439,882 |

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

PRO FORMA STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS

(000 OMITTED)

| | 1958-59 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cash Receipts** | | | | | | | | | | | |
| Earning | | | | | | | | | | | |
| Net Profit | $ | $ 794 | $ 3,175 | $ 5,425 | $ 6,904 | $ 9,541 | $ 11,607 | $ 13,547 | $ 15,100 | $ 16,818 | $ 18,588 |
| Depreciation | | 12,763 | 12,763 | 12,777 | 13,209 | 13,216 | 13,544 | 13,544 | 13,556 | 13,772 | 13,772 |
| Deferred Income Taxes | | 704 | 2,815 | 4,811 | 6,122 | 7,808 | 2,684 | 2,106 | 1,738 | 1,110 | 617 |
| Amortization of Finance Expense | | 349 | 349 | 349 | 349 | 349 | 349 | 349 | 349 | 349 | 349 |
| Total | | 14,610 | 19,102 | 23,362 | 26,584 | 30,914 | 28,184 | 29,546 | 30,743 | 32,049 | 33,326 |
| Borrowed Capital | 337,300 | | | 12,000 | | 9,400 | | 300 | 6,217 | | |
| Common Stock | 64,451 | | | | | | | | | | |
| Total | 401,751 | 14,610 | 19,102 | 35,362 | 26,584 | 40,314 | 28,184 | 29,846 | 36,960 | 32,049 | 33,326 |
| **Cash Disbursements** | | | | | | | | | | | |
| Construction | 350,855 | | 389 | 12,076 | 201 | 9,183 | | 330 | 6,039 | | |
| Interest during Construction | 13,815 | | 8 | 257 | 4 | 195 | | 7 | 128 | | |
| Line Fill | 25,458 | | | | | | | | | | |
| Working Capital | 2,009 | | | | | | | | | | |
| Finance Expense | 8,714 | | | | | | | | | | |
| Debt Reduction | | | | | 17,400 | 17,400 | 17,400 | 17,400 | 17,400 | 17,400 | 17,400 |
| Total | 400,851 | | 397 | 12,333 | 17,605 | 26,778 | 17,400 | 17,737 | 23,567 | 17,400 | 17,400 |
| Annual Excess of Receipts | 900 | 14,610 | 18,705 | 23,029 | 8,979 | 13,536 | 10,784 | 12,109 | 13,393 | 14,649 | 15,926 |
| Cumulative Cash Balance | 900 | 15,510 | 34,215 | 57,244 | 66,223 | 79,759 | 90,543 | 102,652 | 116,045 | 130,694 | 146,620 |

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

CAPITALIZATION

(000 OMITTED)

| | 1958-59 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Capital Requirements | | | | | | | | | | |
| Construction | $350,855 | | $389 | $12,076 | $201 | $9,183 | | $330 | $6,039 | $379,073 |
| Interest during Construction | 13,815 | | 8 | 257 | 4 | 195 | | 7 | 128 | 14,414 |
| Total | 364,670 | | 397 | 12,333 | 205 | 9,378 | | 337 | 6,167 | 393,487 |
| Working Capital | 2,009 | | | | | | | | | 2,009 |
| Line Fill | 25,458 | | | | | | | | | 25,458 |
| Finance Expense | 8,714 | | | | | | | | | 8,714 |
| Total | 400,851 | | 397 | 12,333 | 205 | 9,378 | | 337 | 6,167 | 429,668 |
| Sources of Capital | | | | | | | | | | |
| Borrowed Capital | | | | | | | | | | |
| Mortgages | 208,400 | | | 12,000 | | 9,400 | | 300 | 6,217 | 236,317 |
| Debentures | 128,900 | | | | | | | | | 128,900 |
| Total | 337,300 | | | 12,000 | | 9,400 | | 300 | 6,217 | 365,217 |
| Common Stock | 64,451 | | | | | | | | | 64,451 |
| Total | 401,751 | | | 12,000 | | 9,400 | | 300 | 6,217 | 429,668 |

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

COST OF SERVICE

(000 OMITTED)

| Year | Operating Expense | Ad Valorem Tax | Straight Line Depreciation | Interest and Amortization | Normalized Income Tax | Required Net Profit | Total Cost of Service | MBP Yr. | Cost of Service Per Bbl. |
|---|---|---|---|---|---|---|---|---|---|
| 1960 | $4,624 | $4,376 | $12,763 | $18,057 | $ 9,859 | $11,117 | $60,796 | 73,000 | $0.823 |
| 1961 | 5,093 | 4,376 | 12,763 | 18,049 | 9,017 | 10,168 | 59,466 | 81,760 | 0.727 |
| 1962 | 5,725 | 4,381 | 12,777 | 18,115 | 8,907 | 10,044 | 59,949 | 90,520 | 0.662 |
| 1963 | 7,197 | 4,529 | 13,209 | 18,231 | 7,925 | 8,937 | 60,028 | 99,280 | 0.605 |
| 1964 | 8,034 | 4,531 | 13,216 | 17,369 | 8,436 | 9,513 | 61,099 | 108,040 | 0.566 |
| 1965 | 9,007 | 4,644 | 13,544 | 16,897 | 7,954 | 8,969 | 61,015 | 116,800 | 0.522 |
| 1966 | 9,765 | 4,644 | 13,544 | 15,984 | 7,883 | 8,889 | 60,709 | 122,786 | 0.494 |
| 1967 | 10,504 | 4,648 | 13,556 | 15,121 | 8,159 | 9,201 | 61,189 | 127,772 | 0.479 |
| 1968 | 11,548 | 4,722 | 13,772 | 14,499 | 7,795 | 8,790 | 61,126 | 134,758 | 0.454 |
| 1969 | 12,411 | 4,722 | 13,772 | 13,685 | 7,601 | 8,571 | 60,762 | 140,744 | 0.432 |

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

FIXED ASSETS, DEPRECIATION AND DEFERRED INCOME TAXES

(000 OMITTED)

| Year | Cost | | Straight Line Depreciation @ 3.5% | | Declining Balance Tax Depreciation @ 6.5% | | Excess of Tax Depreciation | Income Taxes Deferred | |
|---|---|---|---|---|---|---|---|---|---|
| | Addition | Balance | Annual | Reserve | Annual | Remaining | | Annual | Cumulative |
| 1958-59 | $364,670 | $364,670 | $ - | $ - | $ - | $ - | $ | $ - | $ - |
| 1960 | | 364,670 | 12,763 | 12,763 | 23,704 | 362,300 | 10,941 | 5,142 | 5,142 |
| 1961 | 397 | 365,067 | 12,763 | 25,526 | 23,575 | 339,122 | 10,812 | 5,082 | 10,224 |
| 1962 | 12,333 | 377,400 | 12,777 | 38,303 | 22,845 | 328,610 | 10,068 | 4,732 | 14,956 |
| 1963 | 205 | 377,605 | 13,209 | 51,512 | 21,373 | 307,442 | 8,164 | 3,837 | 18,793 |
| 1964 | 9,378 | 386,983 | 13,216 | 64,728 | 20,593 | 296,227 | 7,377 | 3,467 | 22,260 |
| 1965 | | 386,983 | 13,544 | 78,272 | 19,255 | 276,972 | 5,711 | 2,684 | 24,944 |
| 1966 | 337 | 387,320 | 13,544 | 91,816 | 18,025 | 259,284 | 4,481 | 2,106 | 27,050 |
| 1967 | 6,167 | 393,487 | 13,556 | 105,372 | 17,254 | 248,197 | 3,698 | 1,738 | 28,788 |
| 1968 | | 393,487 | 13,772 | 119,144 | 16,133 | 232,064 | 2,361 | 1,110 | 29,898 |
| 1969 | | 393,487 | 13,772 | 132,916 | 15,084 | 216,980 | 1,312 | 617 | 30,515 |

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 30" SYSTEM

DEBT SERVICE

(000 OMITTED)

| Year | Principal: Net Additions (Reductions) | Principal: Balance | Interest @ 5.25% | Amortization of Finance Expense | Total | Interest Capitalized During Construction | Interest and Amortization Expense |
|---|---|---|---|---|---|---|---|
| 1958-59 | $ 337,300 | $ 337,300 | $ 13,815 | $ - | $ 13,815 | $ 13,815 | $ - |
| 1960 | | 337,300 | 17,708 | 349 | 18,057 | | 18,057 |
| 1961 | | 337,300 | 17,708 | 349 | 18,057 | 8 | 18,049 |
| 1962 | 12,000 | 349,300 | 18,023 | 349 | 18,372 | 257 | 18,115 |
| 1963 | (17,400) | 331,900 | 17,882 | 349 | 18,231 | 4 | 18,231 |
| 1964 | ( 8,000) | 323,900 | 17,215 | 349 | 17,564 | 195 | 17,369 |
| 1965 | (17,400) | 306,500 | 16,548 | 349 | 16,897 | | 16,897 |
| 1966 | (17,100) | 289,400 | 15,642 | 349 | 15,991 | 7 | 15,984 |
| 1967 | (11,183) | 278,217 | 14,900 | 349 | 15,249 | 128 | 15,121 |
| 1968 | (17,400) | 260,817 | 14,150 | 349 | 14,499 | | 14,499 |
| 1969 | (17,400) | 243,417 | 13,236 | 349 | 13,685 | | 13,685 |

ALBERTA-MONTREAL PIPELINE

SOUTHERN ALTERNATE -- 34" SYSTEM

COST OF SERVICE

(000 OMITTED)

| Year | Operating Expense | Ad Valorem Tax | Straight Line Depreciation | Interest and Amortization | U.S. Subsidiary's Cost of Service | Normalized Income Tax | Required Net Profit | Total Cost of Service | MBP Yr. | Cost of Service Per Bbl. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | $2,569 | $2,989 | $8,719 | $13,006 | $19,427 | $7,023 | $7,919 | $61,652 | 73,000 | $0.845 |
| 1961 | 2,711 | 2,989 | 8,719 | 13,011 | 18,856 | 6,471 | 7,297 | 60,054 | 81,760 | 0.735 |
| 1962 | 2,923 | 2,993 | 8,732 | 13,028 | 18,331 | 5,876 | 6,626 | 58,509 | 90,520 | 0.646 |
| 1963 | 3,158 | 2,996 | 8,740 | 12,742 | 18,356 | 5,848 | 6,594 | 58,434 | 99,280 | 0.589 |
| 1964 | 3,703 | 3,049 | 8,895 | 12,339 | 18,323 | 5,812 | 6,554 | 58,675 | 108,040 | 0.543 |
| 1965 | 4,066 | 3,085 | 8,998 | 11,843 | 18,134 | 5,749 | 6,483 | 58,358 | 116,800 | 0.500 |
| 1966 | 4,363 | 3,109 | 9,070 | 11,284 | 18,020 | 5,642 | 6,362 | 57,850 | 122,786 | 0.471 |
| 1967 | 4,661 | 3,113 | 9,081 | 10,659 | 17,842 | 5,592 | 6,306 | 57,254 | 127,772 | 0.448 |
| 1968 | 5,012 | 3,113 | 9,081 | 10,027 | 17,671 | 5,549 | 6,257 | 56,710 | 134,758 | 0.421 |
| 1969 | 5,341 | 3,113 | 9,081 | 9,395 | 17,485 | 5,504 | 6,207 | 56,126 | 140,744 | 0.399 |

ALBERTA-MONTREAL PIPELINE

U. S. SUBSIDIARY -- 34" SYSTEM

COST OF SERVICE

(000 OMITTED)

| Year | Operating Expense | Ad Valorem Tax | Straight Line Depreciation | Interest and Amortization | Normalized Income Tax | Required Net Profit | Total Cost of Service | MBP Yr. | Cost of Service Per Bbl. |
|---|---|---|---|---|---|---|---|---|---|
| 1960 | $1,137 | $2,247 | $ 3,932 | $ 5,252 | $ 3,704 | $ 3,155 | $19,427 | 73,000 | $0.266 |
| 1961 | 1,208 | 2,247 | 3,932 | 5,252 | 3,357 | 2,860 | 18,856 | 81,760 | 0.231 |
| 1962 | 1,324 | 2,247 | 3,932 | 5,252 | 3,011 | 2,565 | 18,331 | 90,520 | 0.203 |
| 1963 | 1,449 | 2,247 | 3,932 | 5,139 | 3,018 | 2,571 | 18,356 | 99,280 | 0.185 |
| 1964 | 1,775 | 2,298 | 4,021 | 5,005 | 2,821 | 2,403 | 18,323 | 108,040 | 0.170 |
| 1965 | 1,945 | 2,298 | 4,021 | 4,753 | 2,763 | 2,354 | 18,134 | 116,800 | 0.155 |
| 1966 | 2,105 | 2,298 | 4,021 | 4,487 | 2,759 | 2,350 | 18,020 | 122,786 | 0.147 |
| 1967 | 2,271 | 2,322 | 4,063 | 4,271 | 2,654 | 2,261 | 17,842 | 127,772 | 0.140 |
| 1968 | 2,467 | 2,322 | 4,063 | 4,019 | 2,592 | 2,208 | 17,671 | 134,758 | 0.131 |
| 1969 | 2,646 | 2,322 | 4,063 | 3,767 | 2,531 | 2,156 | 17,485 | 140,744 | 0.124 |

ALBERTA-MONTREAL PIPELINE

NORTHERN ALTERNATE -- 34" SYSTEM

COST OF SERVICE

(000 OMITTED)

| Year | Operating Expense | Ad Valorem Tax | Straight Line Depreciation | Interest and Amortization | Normalized Income Tax | Required Net Profit | Total Cost of Service | MBP Yr. | Cost of Service Per Bbl. |
|---|---|---|---|---|---|---|---|---|---|
| 1960 | $3,979 | $5,023 | $14,650 | $20,869 | $11,300 | $12,659 | $68,480 | 73,000 | $0.938 |
| 1961 | 4,205 | 5,023 | 14,650 | 20,861 | 10,200 | 11,569 | 66,508 | 81,760 | 0.813 |
| 1962 | 4,552 | 5,027 | 14,663 | 20,865 | 9,200 | 10,465 | 64,772 | 90,520 | 0.715 |
| 1963 | 4,936 | 5,030 | 14,671 | 20,418 | 9,200 | 10,487 | 64,742 | 99,280 | 0.652 |
| 1964 | 5,912 | 5,134 | 14,975 | 19,892 | 9,000 | 10,114 | 65,027 | 108,040 | 0.602 |
| 1965 | 6,484 | 5,169 | 15,077 | 19,022 | 9,000 | 10,109 | 64,861 | 116,800 | 0.555 |
| 1966 | 6,953 | 5,219 | 15,221 | 18,177 | 8,700 | 9,812 | 64,082 | 122,786 | 0.522 |
| 1967 | 7,439 | 5,222 | 15,233 | 17,170 | 8,550 | 9,677 | 63,291 | 127,772 | 0.495 |
| 1968 | 8,025 | 5,222 | 15,233 | 16,157 | 8,500 | 9,547 | 62,684 | 134,758 | 0.465 |
| 1969 | 8,554 | 5,222 | 15,233 | 15,144 | 8,400 | 9,418 | 61,971 | 140,744 | 0.440 |